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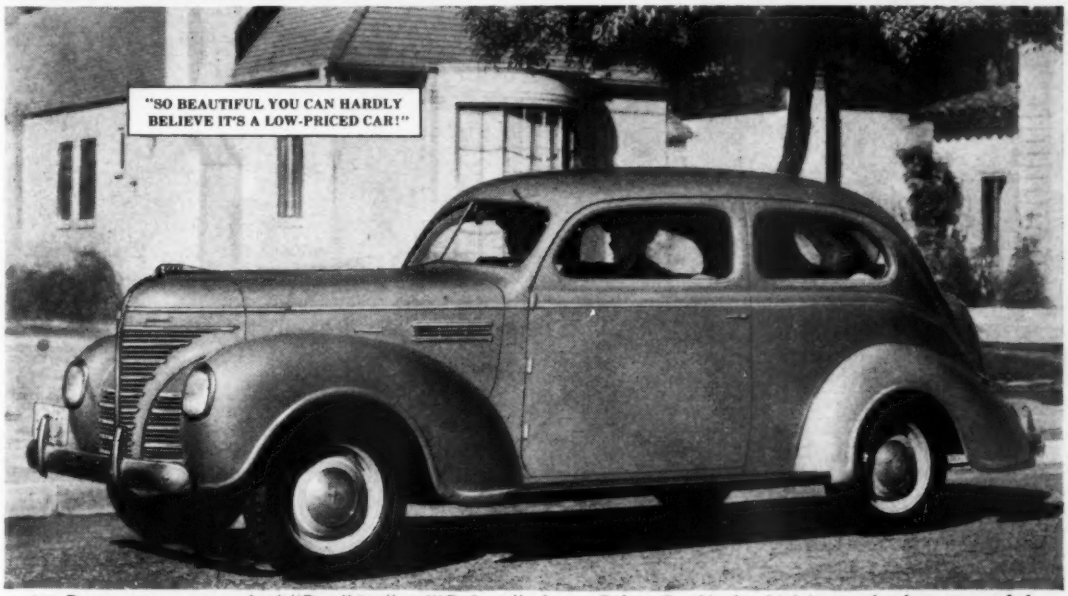

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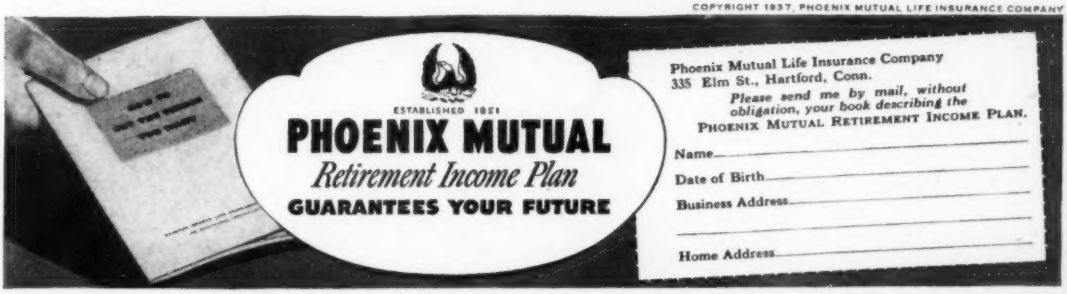
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The day you enroll I start sending Extra Money Job Sheets; show you how to do Radio repair jobs. Throughout your training I send plans and directions, that made good spare time money—$200 to $500—for hundreds, while learning. I send you special Radio equipment to conduct experiments and build circuits. This 50-50 method of training makes learning at home interesting, fascinating, practical. I ALSO GIVE YOU A MODERN, PROFESSIONAL ALL-WAVE, ALL-PURPOSE RADIO SET SERVICING INSTRUMENT to help you make good money fixing Radios while learning and equip you for full time jobs after graduation.

Find Out What Radio Offers You

Act Today. Mail the coupon now for "Rich Rewards in Radio." It's free to any fellow over 16 years old. It points out Radio's spare time and full time opportunities and those coming in Television; tells about my training in Radio and Television; shows you letters from men I trained, telling what they are doing and earning. Find out what Radio offers YOU! MAIL COUPON in an envelope, or paste on a postcard—NOW!

J. E. SMITH, President, Dept. 9CP3
National Radio Institute, Washington, D. C.

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HERE'S PROOF THAT MY TRAINING PAYS

Chief Operator Broadcasting Station

"When I completed 20 lessons I obtained my Radio Broadcast Operator's license and immediately joined station WMPC, where I am now Chief Operator."—HOLLIS F. HAYES, 85 Madison St., Lapeer, Mich.

Over $1,000 Before Graduating

"Before completing half the N.R.I. Course I was servicing sets, and I made $1,000 to $1,200 before graduating. I am doing Radio service work for myself now."—ASHLEY G. ALDRIDGE, 1228 Shepherd St., Petersburg, Va.

$200 to $300 a Month In Own Business

"For the last 18 months I have been in business for myself, making between $200 and $300 a month. I have N.R.I. to thank for start in this field."—ARLIE J. FROEHNER, 224 W. Texas Ave., Goose Creek, Texas.

J. E. SMITH, President, Dept. 9CP3
National Radio Institute, Washington, D. C.

Dear Mr. Smith: Without obligating me, send "Rich Rewards in Radio," which points out spare time and full time opportunities in Radio and explains your method of training men at home to be Radio Experts. (Please write plainly.)

NAME..... AGE.....

ADDRESS.....

CITY..... STATE.....

Our Readers Say

Anyway, the Romans Knew Just How Gaul Was Divided

HAVE often heard people crab about hard mathematical problems, but I doubt if they know what trouble is, compared with the ancient Romans. I never could figure out how the Romans divided or multiplied those queer numerals. For instance, how did they ever divide MCMLVII (1,957) by DXXIV (524)?—L.G.T., Grand Rapids, Mich.

Is It Always Fair Weather Above the English Channel?

ON READING that British and Continental airplane service across the English Channel was canceled for a day recently—for the first time in ten years—I began wondering how European air safety compares with our own. Are any records available to show this? Ten years is an awful lot of uninterrupted flying service!—A.H.A., Dayton, Ohio.

It Doesn't Cost a Cent To Think About It

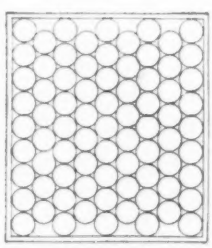
BEFORE I put the cat out and lock up for the night, here is a question I want to ask the legion fans of "Our Readers Say." According to my evening newspaper, a shoemaker, of Italian descent, has received word he has inherited $30,000 in the old country. He wants to remain an American citizen; he can't take the money out of Italy; and the longest passport he can obtain is for ninety days. So, he has to spend $30,000 in three months! Now for the question that occurred to me. Supposing you were left $30,000 with the stipulation that you spend it all in ninety days to aid some work of science, what would you do with the money? Aid infantile-paralysis research? Outfit an exploring expedition? Finance a flight around the world? Buy laboratory equipment for poor students? Maybe you wouldn't do any of these things. But, what *would* you do if you had to dispose of the $30,000?—J.M., Jersey City, N. J.

Why Do That? Nobody Would See It

"ALL this streamlining gets in my hair," says A.R.I., of Mobile, Ala. I believe he means particularly the streamlining of electric razors, lamps, book ends and such, for purely decorative purposes. In that I agree with him, but when it comes to other matters, such as car bodies, I think that the engineers are doing a fine job. But—and it's a big but—why don't they streamline the undercarriages where it is most needed? There are more projecting surfaces and air-flow obstructions there than on car bodies.—A.E., Clinton, Iowa.

In Prose and Poetry the Answers Do Agree

IF B.S., of Chicago, will feint with his left and lead with his chin, and then follow the inclosed diagram, he will find the proper method to inclose seventy-seven 3" by 6" cans in a 6" by 24" by 27" box. That would be five more than he could pack by the conventional method. If he doesn't believe it can be done, let him send me seventy-seven cans of peaches and I will return them to him in a box of the prescribed dimensions—minus the peaches.—J.C., Saginaw, Mich.



If I was packing fruit to sell
In boxes, as you know,
Your straight rows would do very well,
And seventy-two would go.
But if I bought a box to eat
And put them in myself,
Five rows of nine, four rows of eight,
Would put seventy-seven on my shelf.
—L.S., Boxholm, Iowa.

The Roller's "Point" of Contact Is Really a Line After All

READING your magazine for November, I became interested in the problem concerning the roller bearing—whether the roller slips a little, or really rolls without friction. This is the way I look at it. The radius of the sphere of the rollers must be slightly less than the radius of the grooves in the bear- *(Continued on page 14)*

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Will you master fate or will fate master you? That's a question deserving your honest answer...right now! Actually it is largely up to you. You can do with Life almost what you will. LaSalle will help you establish yourself for real success by providing you with the comprehensive, specialized training for which it is so famous. Choose your field . . . now! Check the coupon below for the free booklet you want us to send you. It can be your first step toward assured success.

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Name_____ Age_____

Position_____ Address_____

Our Readers Say (CONTINUED)

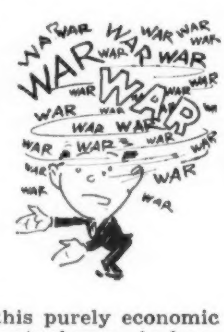
ing races. The sphere of a roller with a radius smaller than the radius of the grooves cannot contact the grooves at more than one point on opposite sides of the roller. Actually, because of the slight deforming of the rollers under load, the contact on each roller will be along a short line, rather than at a single point. Hence, there will be some slippage and friction. Incidentally, if there were no slippage nor friction, wouldn't such a roller bearing in a vacuum be able to coast on forever in perpetual motion?—G.H., Philadelphia, Pa.

There's Considerable Log-Rolling in This Letter

If you can solve this one in fifteen seconds flat, go to the head of the class. A floating pine log, when completely submerged, has just enough buoyancy to support a lumberjack riding it. The log weighs 196 pounds. Its specific gravity is exactly half that of water. How much does the lumberjack weigh? In case you want to know, the log measures one foot in diameter. Its length (neglecting an infinitesimally small fraction) is eight feet. Water weighs 62.4 pounds to the cubic foot. The lumberjack's name is George.—J.H., Seattle, Wash.

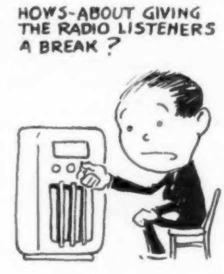
He Wants a Peaceful War at Any Price

Being very much interested—as who isn't these days?—in arming the nation against possible invasion, I want to put in my two cents' worth. The big issue is planes versus warships. Both are expensive, but, for our purposes, the plane expense seems more practical than the ship expense. It is argued that planes become obsolete too quickly. The answer to this is: so do battleships. In the end, planes can be replaced quicker than ships, and the more we force our real or imagined enemies to rebuild their own war weapons in order to keep up with ours, the greater economic strain we impose on them. So long as the international engagement remains on this purely economic basis, we will keep out of actual war. And, regardless of what our wishful thinking indicates we are capable of doing to our enemies in a real war, reason proves to us at once that we can win an economic war with our present potential enemies hands down! So let's build more fighting planes as fast as we can in the interest of peace.—S.D., Troy, N. Y.



But Suppose the Diggers Get Temperamental?

So something has been done at last about the people who like to watch excavations being dug! The "Sidewalk Superintendents' Club" described in your February issue is a step in the right direction, but I am surprised that nobody has thought of commercializing this favorite American diversion. Why doesn't some enterprising promoter buy up the amusement rights on new construction jobs, put up bleachers for spectators, and charge admission? Think of the pride it would give the workers to talk about "their public" and compare their fan mail! Star performers could be given special billing, as "See the Great Tony at the Console of the Mammoth Steam Shovel." If tens of thousands of fans will pack into a stadium to see twenty-two young men grind one another's faces into the mud, what a crowd you could draw with a battery of pneumatic drills and a few sticks of dynamite!—M.A.J., New York City.



Even the Cat's Whiskers Do Their Bit

Evidently the man who made the artificial cat for the article "Why Do Cats Always Land on Their Feet?" in the January issue thinks that he has demonstrated by it that a cat "flips itself over with its tail." I think a cat exerts itself all over in turning in the air, and that the tail helps only a little bit. There are plenty of tailless cats in the world, and the wonder is that some one has not before now proved that such cats either can or cannot turn in the air. It seems a little absurd that the tail, which weighs probably not more than one twentieth of the whole body's weight, could have much to do with turning a cat. Boys used to have a conundrum: Why does a dog wag its tail? Answer: Because the tail can't wag the dog. If the source of the power in turning a cat is in the tail, then the *(Continued on page 16)*

On His Record—
Which Man Would YOU Hire?

You Are Hired on YOUR Record—
Employers Want to Know, Are YOU Prepared for Promotion

Your own ability to hold the better jobs depends entirely on the preparation you have made to accept the **opportunities offered every month in the year** in the active fields of today such as Air Conditioning, Diesel Engineering, Drafting and Design, etc. Men in these fields and others with preparation as accountants and in merchandising are being advanced into such openings as department heads, managers, foremen, superintendents, travelling auditors, etc.

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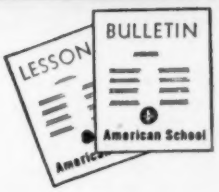


*Name*_____ *Age*_____ *Occupation*_____

*Street*_____ *City*_____ *State*_____

ADVERTISING PAGES REMOVED

Our Readers Say (CONTINUED)

tail wags the cat, upsetting the theory of the old conundrum.—W.E., Wells River, Vt.

How To Steamline That Old Double Boiler

RECENTLY I learned for the first time that it will raise the boiling point of water if you dissolve various salts in it. Now I'm wondering if the idea might have practical use in household cooking. For example, the temperature in the top of a double boiler can't get higher than 212 degrees (actually, because of heat loss, a few degrees less than this) when plain water is used below. But suppose you wanted to cook something at a steady heat of, say, 220 degrees. Just add the proper amount of the right kind of salt, in the bottom of the double boiler, and it would do the trick! Handier than a pressure cooker, I'd say. To prove the point to my doubting wife, I dumped eight or nine heaping teaspoonfuls of ordinary table salt into the water in the bottom of a double boiler—and some sugar, too, which may or may not have helped! After working on it for quite a while, I was able to boil the water in the top of the double boiler, a sight she had never seen before. There are other chemicals that would work better than table salt, such as calcium chloride; and also ammonium chloride, sold as sal ammoniac.—G. H., Bangor, Me.

What Kind of a Curve Has a Suspension-Bridge Cable?

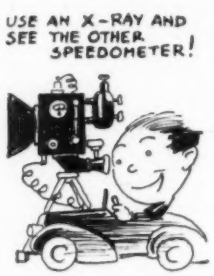
CAN one of your readers tell me if the main cables of suspension bridges hang in a natural catenary curve, or are pulled into a segment of a circle by the vertical bridge supports?—I.A., Athens, Ga.

After This He'd Better Stay on His Own Reservation

THUMBING through the February issue rapidly, as I always do before settling down to read it, I was struck by the remarkable resemblance of three of the pictures in it to three well-known public figures. I wonder if anyone else noticed them too. Here they are: On page 67, Roosevelt; on page 131, Mussolini, and on page 142, Hitler. Just now, while glancing back through the magazine, I found a picture on page 146 of a man riding a motorcycle through a stream. He looks like a certain one-time equestrian who, if he were on a horse, and kept on going, would presently come a cropper. You guessed it—the Duke of Windsor. If you want to see a picture that looks like me, look at the guy in the circle in the top, right-hand corner of the advertisement inside the back cover.—D.V.S., Washington, D. C.

Not According to the Rules in Rule, Tex.

IN REFERENCE to the speedometer-camera car on page 64 of the January issue, I think that it is a bum idea. Couldn't a driver of the car going sixty miles an hour pull up behind a truck or private car doing twenty miles an hour, snap a picture, then pull out around him and have "proof" he was doing sixty? I suppose the trees are doing sixty miles an hour because they are in the picture, too. This evidence is very inaccurate and might be unfairly used.—J.G.M., Rule, Tex.



He's Up in the Air About That Airplane Motor

ON PAGE 103 of the December issue, that does not look like a Gnome Monosoupape engine to me. In all my flying experience, dating back to 1912, I never saw a Gnome Monosoupape with inlet pipes. On the Gnome Monosoupape, the exhaust push rods were exactly in line with the axes of the cylinders—in the photo, the rods are not in this line. I believe that the engine is a Le Rhone.—W.H.S., Philadelphia, Pa.

If It's That Familiar Red Kind, There's No End to It

A ROLL of tape has been used until it is down to six inches in diameter. The hole in the center of the roll is an inch in diameter. The tape is five thousandths of an inch thick. The owner of the roll has been using five yards a day and wants to know on that basis, how many days it will be before he must start another roll. I would like to know, in addition, how big the roll was to start with, if he had been using it 300 days when it got down to its present size of six inches. We sixty-five-year-old duffers still know our figures. Your paper is very much improved since you started. Since it was born two years before I was, I can't say that I've read every copy. But I've been reading them all for quite some time now.—H.S.H., St. Paul, Minn.

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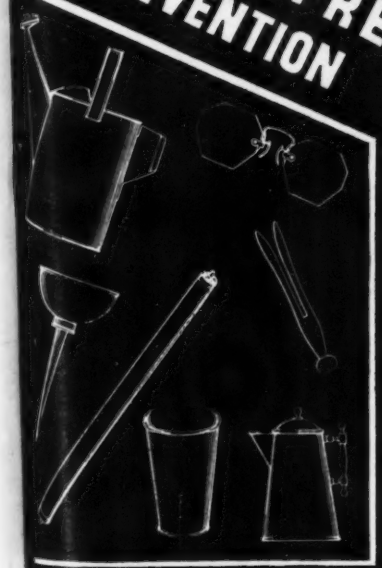

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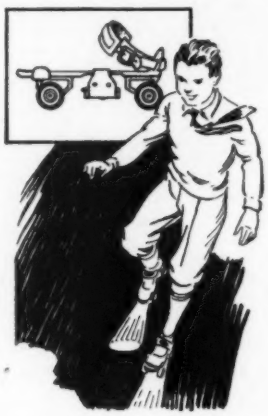
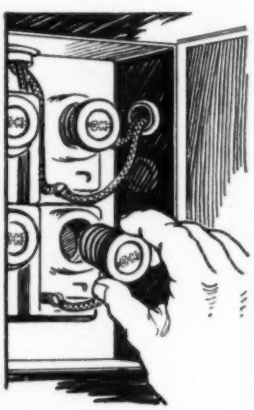
With the Inventors

DUMPING of gasoline from an airplane in flight, sometimes necessary in emergencies, is always a dangerous procedure, since gasoline fumes surrounding the plane or seeping into the fuselage may be ignited by a spark, thereby turning the ship into a flying bombshell plunging earthward in a mass of flames. To forestall this, Fred A. Jones, of Newark, N.J., has invented a novel safety device: A long hose connected through a

dump valve to a plane's fuel tanks is attached to a parachute and housed in a compartment near the tail of the ship. In an emergency, the pilot yanks a lever to eject the hose from its compartment, and the parachute balloons out, carrying the hose with it. With the outlet of the 'chute-supported hose trailing far behind the plane, gasoline-dumping hazards are reduced to a minimum . . . IN PROPORTION TO ITS POPULATION, Switzerland produces more inventions than any other nation in the world . . . PLATES ARE KEPT WARM at the dinner table by an ingenious electric heating pad devised by Lill K. Frolich, of Louisville, Nebr. Plate-size heating elements are embedded in sections of noninflammable padding that lie flat on the table underneath the tablecloth. When more than the usual number of places are to be set at the table, additional sections may be added, just as extra leaves are inserted to enlarge a dining table, since each pad section is provided with a plug on one edge, and on the other edge there is a socket for connecting it electrically with adjacent sections. One of the end pad sections has an extension cord that is plugged into a wall socket . . . THE NUMBER OF CLAIMS appended to a patent is no indication of its potential value to the inventor. Although one patent that contained over 700 claims made several million dollars for its owner, another patent which contained only thirteen claims earned even more . . . ROLLER SKATES are the subject of two recent inventions. One, worked out by Theodore R. Goettie, of Wayne, Pa., gives the roller skate brakes. Brake shoes, normally held in a released position by helical springs, are forced against the skate rollers by means of a control strap extending upward to the hand of the skater. The brain child of Mikaly Galgoczy, of Cleveland, Ohio, is an attachment that gives the roller skate "headlights." A flash-light cell and bulb are supported in a frame that hangs down from the bed of the skate between the front and rear rollers . . . APPROXIMATELY TWO THIRDS of all the patents filed at the Canadian Patent Office are issued to American inventors . . . AN ELECTRIC FUSE, for which credit goes to Hrand M. Muncheryan, of Los Angeles, Calif., contains a fuse-metal strip formed into the letters "OK." If the fuse burns out, the letters melt while all others in the fuse box will still read "OK." . . . ONE OF THE MOST COMPLICATED MACHINES ever invented by one man was the Paige type-composing machine. The patent covering it contained fifty-five pages of printed text in addition to more than 160 sheets of drawings . . . NUMBERED AMONG THE CONSTANT FLOOD of inventions relating to automobiles are: A car having its motor placed sidewise instead of lengthwise on the chassis; a steering-gear





(Continued on page 24)

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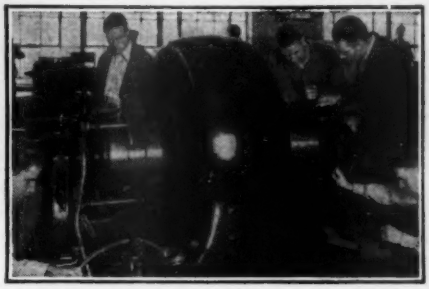

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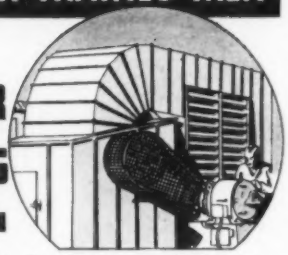

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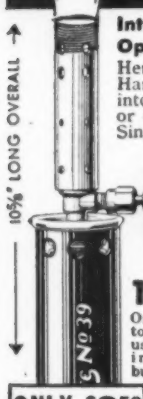

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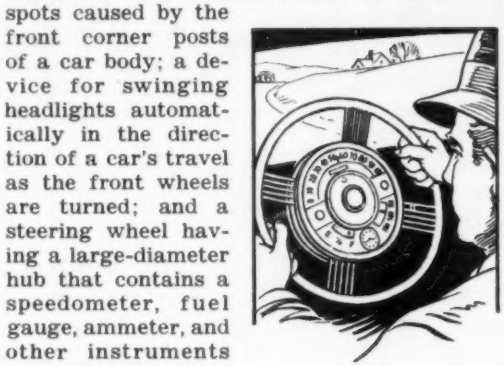
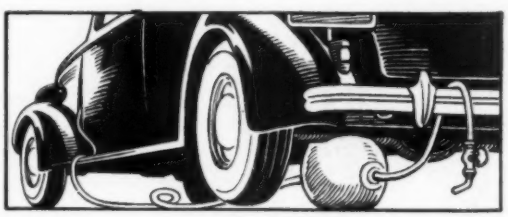
With the Inventors

(Continued from page 22)

attachment that automatically slows a vehicle down when rounding a sharp curve; a front-view mirror that eliminates the blind spots caused by the front corner posts of a car body; a device for swinging headlights automatically in the direction of a car's travel as the front wheels are turned; and a steering wheel having a large-diameter hub that contains a speedometer, fuel gauge, ammeter, and other instruments generally mounted on the dashboard . . . PATENTS ARE NOT TAXED in the United States, although in some foreign countries, owners must pay an annual tax on each of their patents, or have them lapse . . . HOUSEWIVES should have little trouble in cleaning a new double-hung window that also swings inward like a casement type. The sash, fitted with conventional counterweights, slides up and down along side channels, but is hinged at one edge so that it can be opened inward at any time. William C. Jones, of Tappan, N.Y., and Gustav Siese, of Park Ridge, N.J., are the joint originators . . . THE 50,000,000 PRINTED COPIES of patents kept on file at the U.S. Patent Office are housed in steel cases that cover more than thirty miles of shelving . . . AUTOMOBILES JACK THEMSELVES UP under their own power with a balloon-type pneumatic jack perfected by Robert V. Morse, of Ithaca, N.Y. Operated by motor





(Continued on page 26)

Easy as A-B-C

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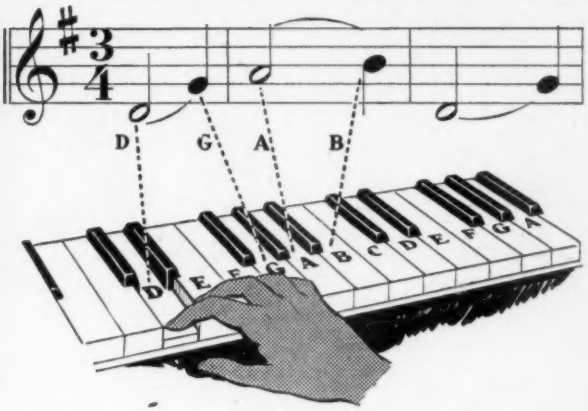

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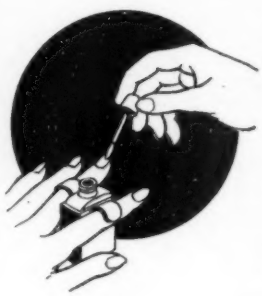
With the Inventors

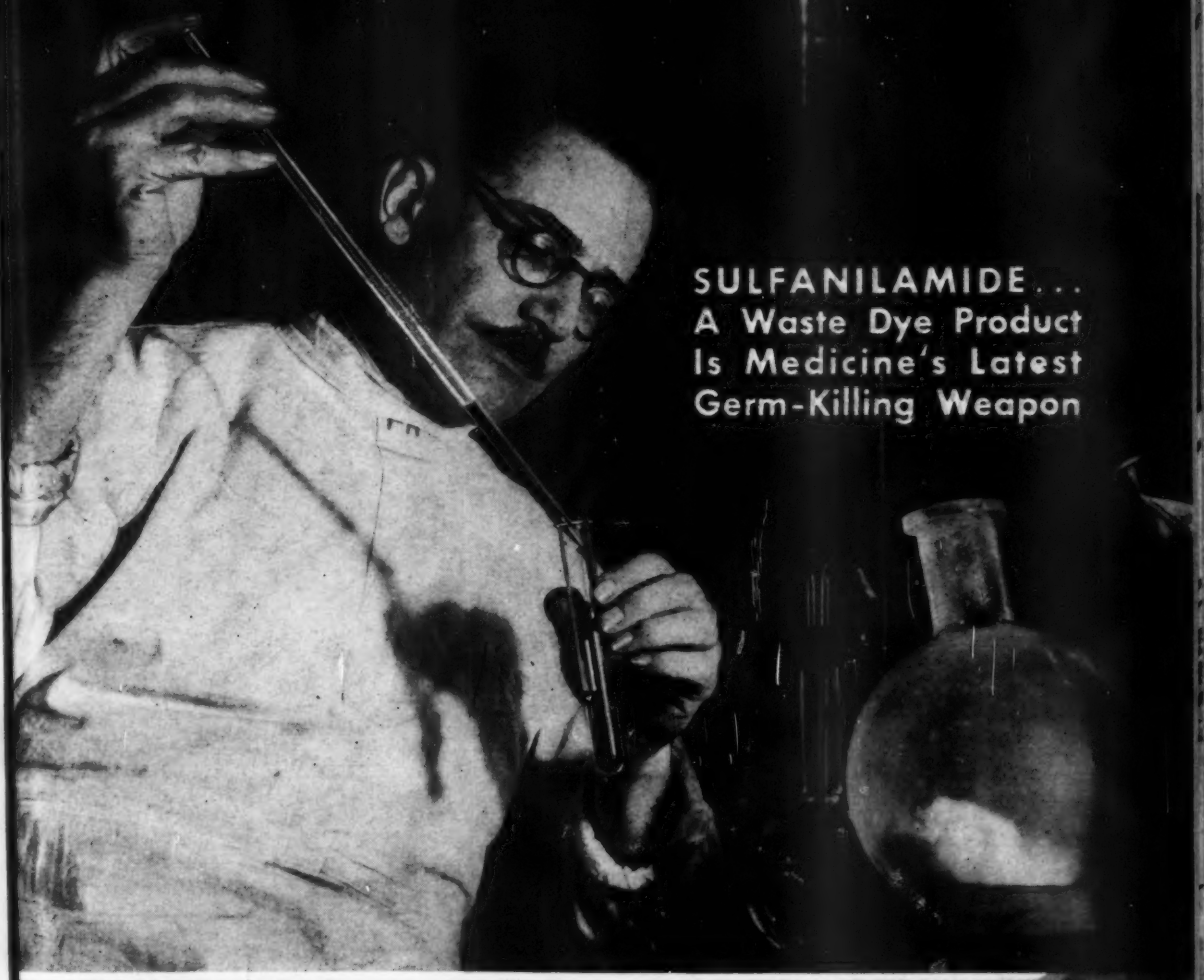
(Continued from page 24)

compression, a pump screwed on in place of a spark plug is connected by a rubber hose to an inflatable bag placed beneath the car axle. When the motor is started, the bag fills with air to jack up a wheel. Opening an outlet valve releases the air from the balloon jack, lowering the car to the ground . . . TWO OUT OF EVERY EIGHTY PATENTS pending at the patent office, examiners estimate, contain claims to the same invention . . . TO ENCOURAGE SYSTEMATIC SAVING, a novel coin bank invented by David H. Zell, of Brooklyn, N.Y., has a built-in rotating calendar which advances from one date to the next only when a coin is inserted in a slot at the top. Pushing the coin down through the slot into the bank actuates a gear mechanism that turns the calendar dial to keep it up to date . . . AN ADJUSTABLE REFLECTOR developed by Samuel Margulies, of New York City, is designed to increase the usefulness of a flash light. A mirror pivots on a U-shape bracket jutting up from clamps fastened to the bulb end of the light, so that the latter can be stood up vertically and the mirror adjusted to throw a beam downward or to one side . . . CONVENIENCE in applying nail polish is the aim of an invention of Alice Jefferis, of Washington, D. C. A container fitted with curved tabs holds the polish, while the tabs support the container on two fingers.



POPULAR SCIENCE MONTHLY

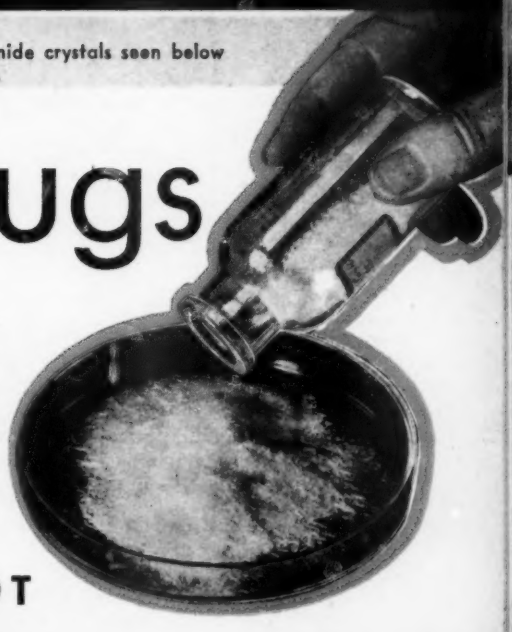
RAYMOND J. BROWN, *Editor* . . . MARCH, 1939



SULFANILAMIDE . . .
A Waste Dye Product
Is Medicine's Latest
Germ-Killing Weapon

Dr. Hugo Bauer seeks new forms of sulfanilamide, such as the disulfanilamide crystals seen below

King of Drugs



"ABSCESS of the brain, with death practically certain." That was the tragic diagnosis Chicago, Ill., surgeons were forced to make not long ago as they concluded an emergency operation on a little four-year-old girl. For the surface of the child's brain was swarming with streptococcic germs, deadly bacteria whose cells cling together like links of a chain. This indicated the inevitable onset of meningitis, a dreaded disease that had always killed with deadly certainty ninety-nine out

By E. W. MURTFELDT

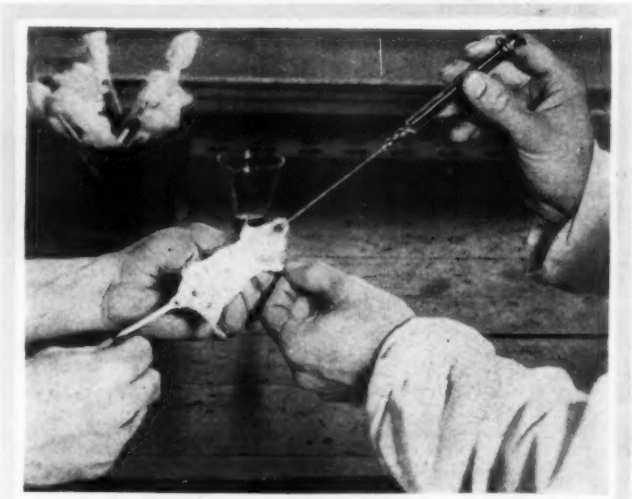
This mouse is getting a shot of the streptococcic germ culture prepared by Dr. Sanford M. Rosenthal in the photograph at the right. Soon it will be very sick, and will be treated experimentally with the new wonder drug

of every 100 persons it attacked.

In spite of the apparent hopelessness of the case, however, doctors grimly refused to admit defeat. They tried everything known to science, and as a last resort administered a few grains of a newly discovered drug derived from a chemical dye. Miraculously, the girl's soaring fever was checked.

More of the drug was given. Hour by hour, physicians and nurses watched the slender column of mercury in the fever thermometer creep downward toward normal. In a few days, doctors pronounced the child out of danger. And in two weeks, she went home from the hospital, once again a healthy, happy youngster, thanks to the magic of a drug produced by chemical research.

This miracle drug, now known by the tongue-twisting name of sulfanilamide, was announced to the world barely three years ago, and yet today it is recognized as one of the greatest discoveries in the history of medicine, a potent weapon in combating not only meningitis, but also thirteen other diseases, including scarlet fever, blood poisoning, and other ailments caused by germ infections. And in laboratories all over the world, chemists are concocting new derivatives of sulfanilamide for medical warfare on still other diseases, while hospitals, clinics, and medical schools are daily reporting amazing, almost magical cures with this "king of drugs."



Here the mouse is being given a dose of sulfanilamide through a tube that reaches down through its throat and into its stomach

In Baltimore, Md., for example, a patient

suffering from a streptococcic infection of the mastoid bone behind the ear was practically burning up with a fever that skyrocketed to 106 degrees. Sulfanilamide was injected. Twenty-four hours later, the temperature had dropped to 100. After two days, the patient was propped up in bed, eating a hearty breakfast.

In London, at Queen Charlotte's Hospital, a young Englishwoman suffering from another streptococcic infection, puerperal, or childbirth, fever, had been given less than a fifty-fifty chance to live. But on the morning following the administering of this magic drug, her temperature was close to normal, and in twelve days she was completely well. At this same hospital, as a test, sulfanilamide was given to thirty-eight "hopeless-case" fever patients. Thirty-five of them recovered to the physicians' amazement.

Useful new derivatives of sulfanilamide are constantly being sought in the laboratory. Some of them are seen above, backed by nitroaniline and sulphuric acid, the raw materials

Yet, only a few years ago, the dyestuff from which sulfanilamide was developed was being shoveled around as waste in the plant of a German dye firm, with no one suspecting its incalculable value to medicine and to human life. Then, in 1932, chemists produced from this waste a compound they called prontosil, a ruby-red liquid dye whose action in combating streptococcic germs seemed too good to be true. After three years of testing to determine the chemical's value beyond any doubt, Dr. Gerhardt Domagk finally announced the drug to the world by reporting a dramatic experiment that represented a giant forward stride in the march of medical progress.

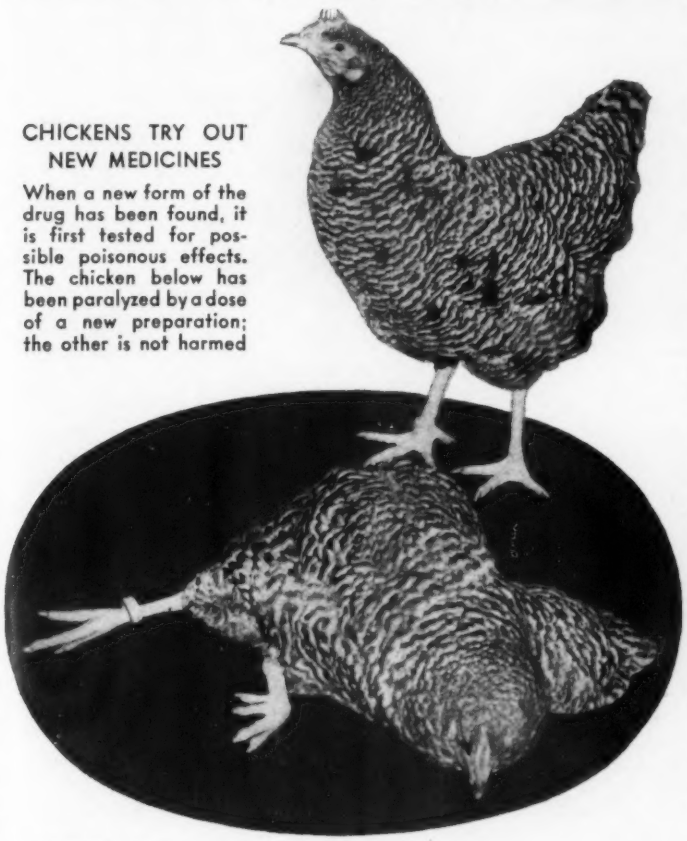
With a hypodermic needle, Dr. Domagk shot millions of the deadly germs into the bellies of twenty-six mice. Shortly afterwards, he poured prontosil down the throats of thirteen of the animals. After several days, the prontosil-treated mice were alive and as chipper as ever. The untreated thirteen, however, were dead.

In medical circles, the news spread rapidly. Domagk's experiment was checked and rechecked by British physicians. French chemists furthered the work by isolating sulfanilamide, the active ingredient in prontosil. News of the drug was brought to the United States by Dr. Perrin Long, of Johns Hopkins Hospital in Baltimore, who with Dr. Eleanor Bliss, his associate, started sulfanilamide experiments on animals.

Soon, however, this medical-research team had an opportunity to put the drug to a more practical test. A Baltimore girl was admitted to the hospital seriously ill with erysipelas, another dangerous streptococcic

CHICKENS TRY OUT NEW MEDICINES

When a new form of the drug has been found, it is first tested for possible poisonous effects. The chicken below has been paralyzed by a dose of a new preparation; the other is not harmed



infection. The disease spread in spite of blood transfusions and antitoxin injections. Treatments with sulfanilamide were started. One day later, the patient's temperature was normal. Soon, the first American ever treated with sulfanilamide had completely recovered.

Knowledge of this miracle drug was confined almost entirely to medical and chemical circles until two news events brought the name of sulfanilamide before the public. Late in the fall of 1936, Franklin D. Roosevelt, Jr., contracted septic sore throat. Prontylin, a form of the original prontosil, helped to cure him, and the public recalled that, a dozen years before, physicians who had had no knowledge of this new drug had been unable to save the life of another president's son, Calvin Coolidge, Jr., who succumbed to a streptococcic infection in his foot.

The second event that publicized sulfanilamide shocked the nation. A southern drug-supply house concocted an elixir of sulfanilamide by mixing the drug with diethylene glycol, an organic chemical used as a solvent. This preparation was shipped to drug stores all over the country. Then, without warning, six persons in Tulsa, Okla., who had taken the elixir, became ill and died.

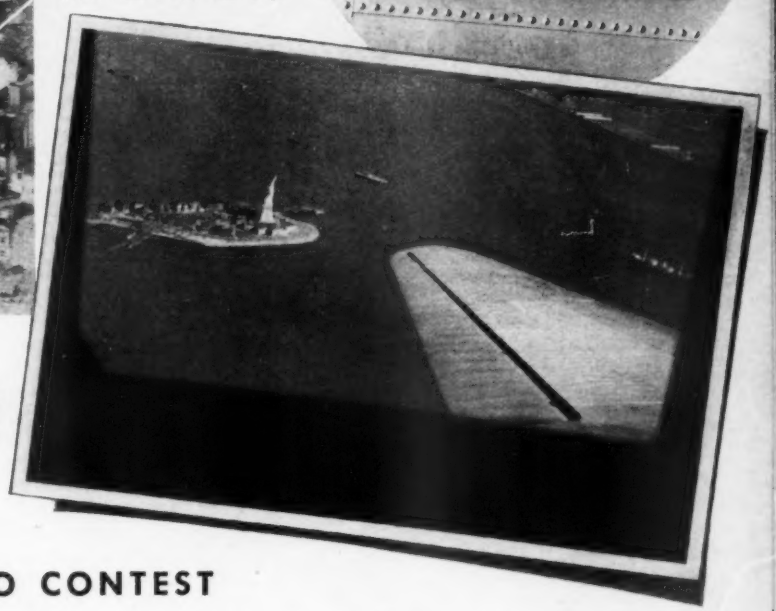
National health authorities mobilized for action. The Federal Food and Drug Administration started a nationwide race with death, sending every available agent scouring the country in search of the 700 bottles of elixir that had been shipped. American Medical Association laboratory technicians tested the compound and pronounced it poisonous. Telegrams of warning were rushed to state and local health authorities. Many arrived too late, however, and the death toll finally mounted to more than seventy.

What caused these tragic deaths? Was sulfanilamide a Jekyll-Hyde drug, conquering suffering and death in some cases, only to transform itself into a deadly poison in others?

No, replied medical authorities, for in the poisonous elixir, the culprit was diethylene glycol, the chemical solvent, not sulfanilamide. Although the miracle drug by itself may produce unpleasant reactions such as nausea, dizziness, *(Continued on page 250)*

Sulfanilamide is administered to human patients either by injection, as above, or in tablets by mouth

Amateur photographers taking pot shots from an airliner over New York. The pictures of the fan at right and of the Statue of Liberty were made on the trip



Camera Fans Go Aloft

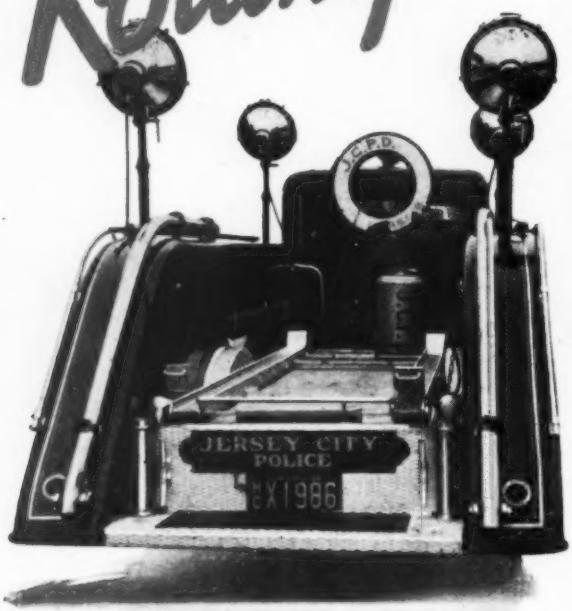
IN AERIAL PHOTO CONTEST

RIDING in great metal airliners that circled over New York City, Long Island, the site of the World's Fair, and New York Harbor, more than 200 camera fans recently took part in an aerial outing. Prizes were offered for the best photographs obtained during the flights. Everything in the way of equipment from miniature outfits to elaborate moving-picture cameras rode in the planes. Some amateurs took along a battery of lenses that enabled them to snap distant views, wide-angle shots of the interior of the plane, and close-ups of their fellow fans. Some of the pictures they got are seen on this page.

Marine emergency truck built by Jersey City, N.J., policemen. It carries a small speedboat

POLICE CRAFTSMEN BUILD Rolling Boathouse

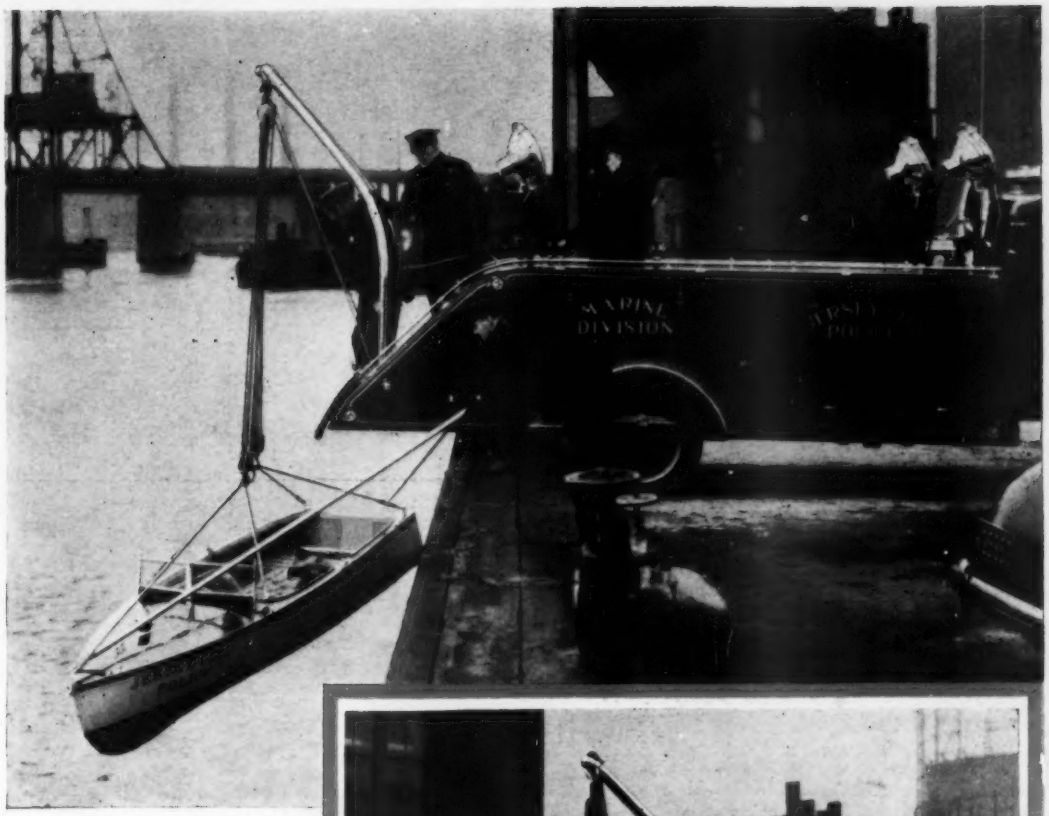
By
ROBERT E. MARTIN



Rear of truck with boat removed. Shiny rails at sides are demountable davits. In circle, officer using two-way radio

SIREN screaming, a rakish, shiny green truck swings out of a police garage in Jersey City, N.J., roars down the main street, and races eastward toward the Hudson River. At a waterfront pier, bystanders gape with astonishment as a sleek, sixteen-foot speedboat slides down from the truck body. In a flash, police haul it up on demountable davits, swing it out over the pier end, and lower away. Seconds later, a powerful outboard motor coughs into action and a detail of police is racing out to a harbor rescue.

That is a typical scene when waterfront disasters summon Jersey City's new marine emergency truck, a streamline, twenty-four-foot boathouse on wheels that is equipped for any job, from rescuing a drowning person to trapping criminals smuggling goods ashore from incoming liners. Believed to be the only vehicle of its kind, the



With the truck backed up to the edge of a pier, the boat is lowered from the davits, after being lifted from its wheeled carriage as at right

rolling boathouse is the pride and joy of local cops and firemen, not only because it is a remarkably efficient rescue machine, but also because they designed and built it themselves.

Starting only with a commercial truck chassis and a motor launch, police craftsmen shifted their badges from uniforms to overalls, manned the power lathes, band saws, and paint frames in the fully equipped city repair shops, and turned out an emergency marine truck that is a masterpiece in both design and execution. Washed and polished by its crew as lovingly as any home-workshop fan ever groomed a prize project, the ingenious truck is stationed at a central point within water-bound Jersey City so that it can be rushed quickly to any spot on the city's twelve-mile waterfront.

Over seven feet wide, with a wheelbase of more than fifteen feet, the chromium-trimmed truck carries its length gracefully, sweeping down to a tapering rear-end overhang that will jut out over the end of a pier to allow

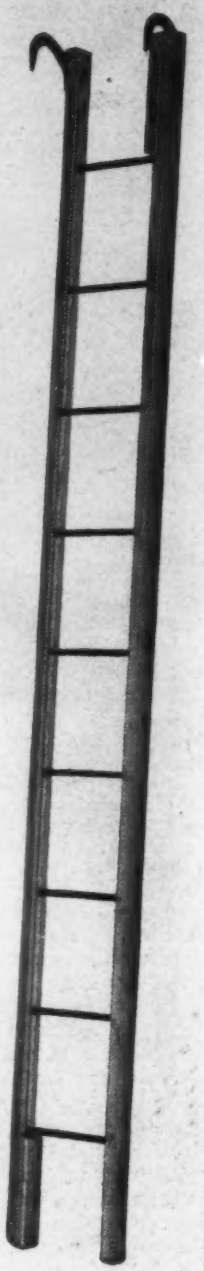
An officer at work in the police machine shop where the unusual emergency vehicle was built. Members of the force designed various details

the launch to be lowered directly into the water from a height as great as twenty-five feet.

Four portable 500-watt floodlamps, powered by a 5,000-watt generator driven by the truck motor, top steel standards at the corners of the body. Special tripods and cable are carried to enable police to set up and operate the lights at points remote from the truck. In the driving cab, a two-way dashboard radio permits instant communication with headquarters, no matter where the truck may be.

Within the body of this rolling boathouse, the trim, green-and-white speed launch is carried on a cradle equipped with balloon tires that rest in the grooves of two sliding steel skids. On a sloping beach, the skids are pulled backward and lowered to form a ramp down which the cradled boat is rolled and then launched directly into the water. On a pier, the craft is rolled to the ground, hauled up by block and tackle onto steel davits snapped into open sockets, the truck itself is backed to the pier edge, and the boat lowered into the water.

Lining both sides of the truck body are spacious compartments containing every conceivable item of emergency equipment: life-preserver belts, a rope ladder, inhalators for use in drowning cases, blankets, chemical heat



Here's another creation of the craftsmen cops—a ladder which folds up into a pole to fit into narrow places

For recovering bodies from the water, police devised this grapnel with codfish hooks that pull loose if snagged

Corks cover the points of the hooks when the grapnel is not in use

packs, vacuum bottles, hawsers, bilge pumps, first-aid kits, kerosene lanterns, rubber gloves for handling live electric wires, a Lyle gun for shooting a rescue line, and dozens of other items. Special grapnels for dragging for bodies, designed and made by the police themselves, have rows of codfish hooks attached to cross bars by novel spring swivels. If one hook snags on the bottom, police may lose it, but not the whole grapnel.

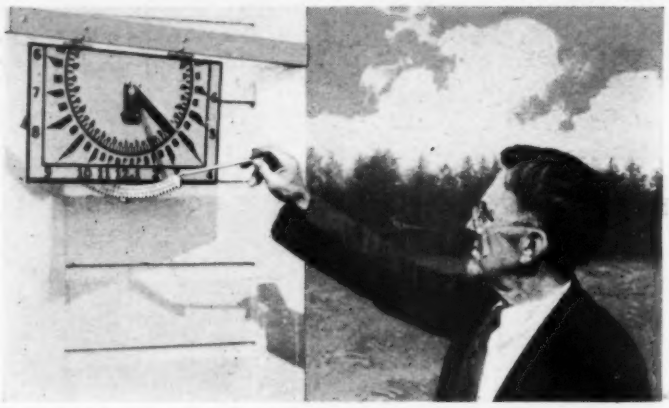
Another odd device credited to the ingenuity of these police mechanics is a divided twelve-foot pole fitted at the top with strong steel hooks. Pull the two divisions of the pole apart, and it becomes a ladder, the hinged rungs swinging down from a vertical to a horizontal position. The cops explain that they can work the pole into spots where a conventional ladder would not go.

No waterfront emergency stumps these marine police. "We've got every piece of equipment we've ever needed so far," they say. "And if some new emergency crops up that demands a special device, why, we'll just whip it into shape in the shop."

To launch the boat on a sloping beach, it is run down skids and into the water on its rubber-tired carriage

Adjustable Sun Dial Keeps Good Time

HELD in a vertical instead of the usual horizontal position, a curious sun dial invented by W. G. Brown, of Salisbury, N.C., tells accurate time at all seasons of the year. The dial of the instrument swings so that its plane may be adjusted to keep the style, the metal shadow-casting arm, always at right angles to the sun's rays at high noon. This adjustability reduces the margin of error found in horizontal, stationary sun dials because of the progression of the seasons, as the sun appears to move northward or southward.



A notched arc adjusts the dial plane to allow for seasonal changes

Track sections are mounted on realistic bases resembling a roadbed

Toy Electric Train Uses No Third Rail

REALISTIC two-rail track is a feature of a new electric-train outfit. No center or outside third rail is needed to power the train, as current flows through the running rails. Car wheels on the train are made of an insulating plastic material to prevent short-circuiting through the axles. Current is picked up by two small brass wheels on the locomotive. Made in "HO" gauge, the tracks are solid drawn steel, each section being mounted on a realistic base designed in imitation of a railroad roadbed.

Grading Machine Cuts and Loads

SPEEDING construction of fire roads in national forests, a "double-jointed" grading machine slices down banks and loads a waiting truck in a single operation. Seven planetary clutches controlling the various movements are operated from one lever bank by finger-tip control. The apparatus can be turned in a complete circle, and two types of buckets enable it to pull materials down into a ditch or to pick them up.

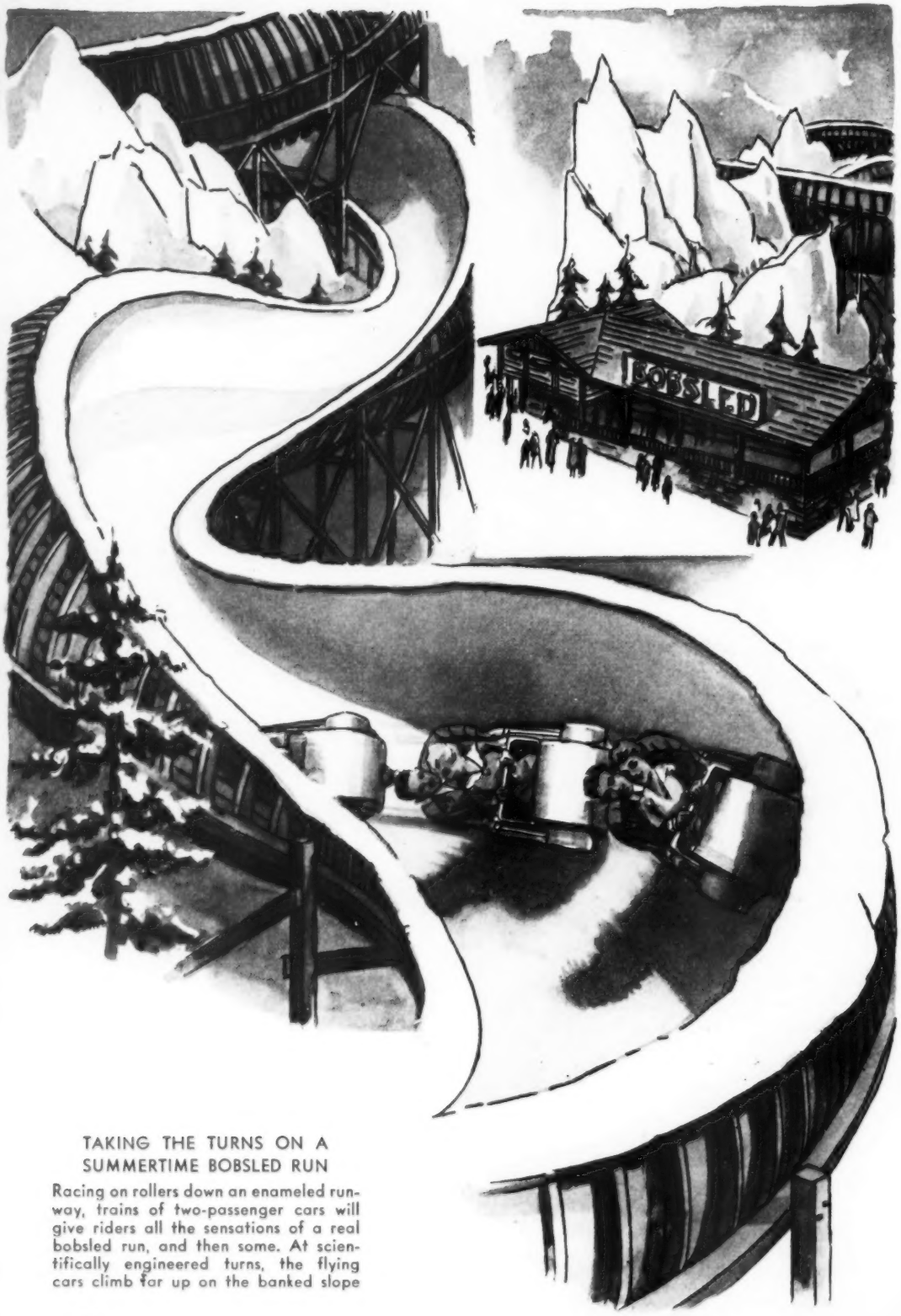
"Double-jointed" grader at work. One man controls its many movements

World's Fair Thrills

DRIFTING TO EARTH IN A PARACHUTE

Eleven gayly colored captive parachutes operated from this 250-foot tower will offer a thrill combined with the best view of the fair grounds

WHEN the New York World's Fair opens its gates, a few weeks hence, its exhibits of the wonders of art and industry will have to vie for visitors' attention with the attraction of a veritable city of fun-making devices. By invoking the aid of science and engineering as never before, ingenious designers have outdone themselves to create new thrills for excitement-seeking patrons, in a mile-long "Amusement Zone" that flanks the other exhibits of the exposition. A preview of their innovations, on these pages, gives a fascinating glimpse of what awaits the fair-goer.



TAKING THE TURNS ON A SUMMERTIME BOBSLED RUN

Racing on rollers down an enameled runway, trains of two-passenger cars will give riders all the sensations of a real bobsled run, and then some. At scientifically engineered turns, the flying cars climb far up on the banked slope

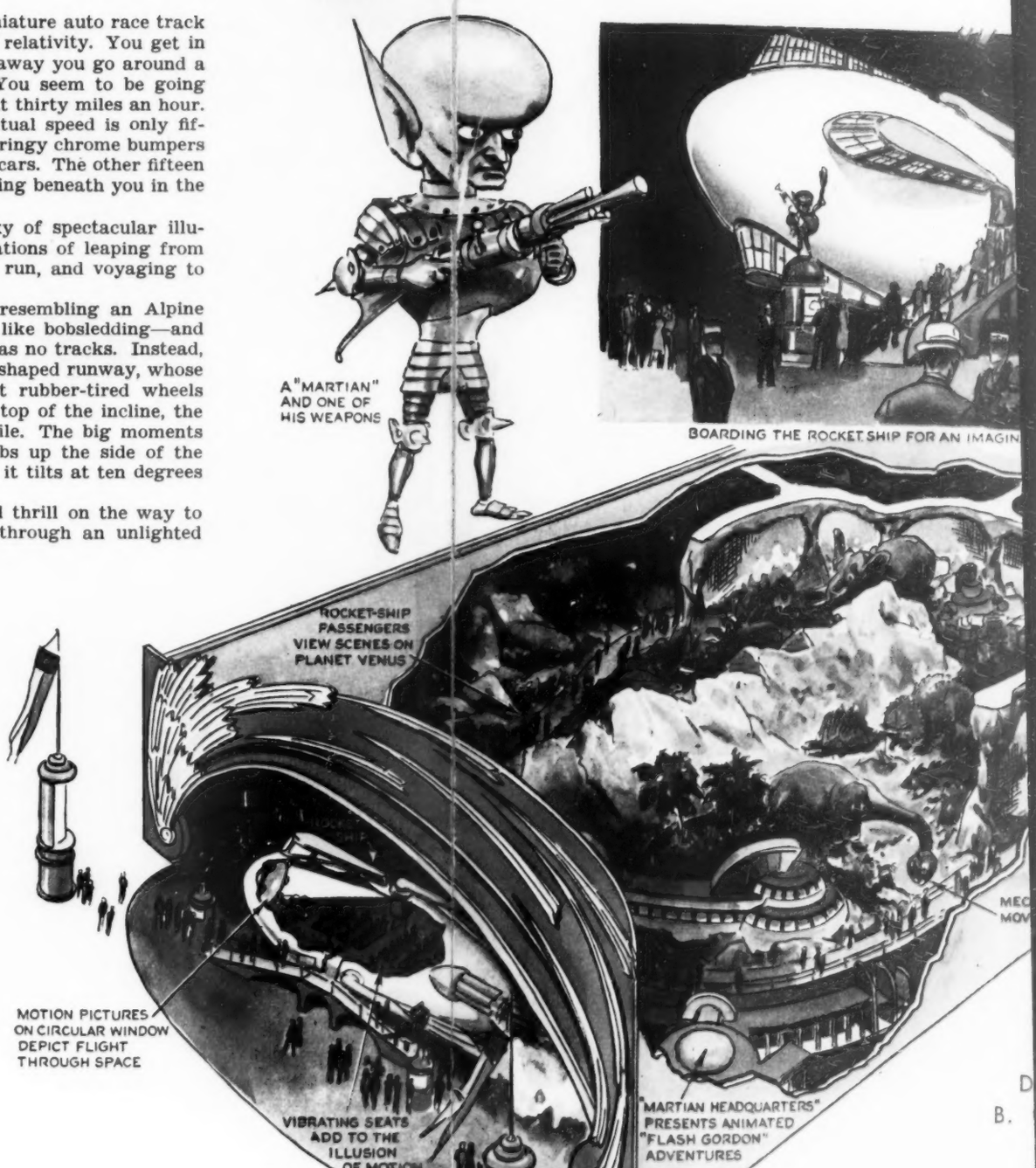
Einstein himself might enjoy a ride upon the miniature auto race track called the Drive-A-Drome—for it's all a matter of relativity. You get in a tiny gasoline-powered car, step on the gas, and away you go around a bowl, racing neck-and-neck with other drivers. You seem to be going fast, for the scenery outside the bowl flashes past at thirty miles an hour. But you needn't worry about a collision. Your actual speed is only fifteen, the limit to which the car is geared, and its springy chrome bumpers easily absorb the shock when you bump into other cars. The other fifteen miles an hour is the speed of the bowl itself, revolving beneath you in the direction you are traveling!

Scientific stunts like this have created a galaxy of spectacular illusions. You can taste for yourself the actual sensations of leaping from an airplane, flying one, careering down a bobsled run, and voyaging to the heart of Africa or to a distant planet.

On the gayly decorated midway, an entrance resembling an Alpine scene leads to the giant coaster that gives a ride like bobsledding—and then some. Unlike most roller coasters, this one has no tracks. Instead, a train of five aluminum cars races down a trough-shaped runway, whose white-enameled surface simulates snow, on silent rubber-tired wheels that swivel like casters. Towed by a chain to the top of the incline, the train begins its hair-raising coast of a quarter mile. The big moments come when the string of two-passenger cars climbs up the side of the banked runway at the turns. Rounding one curve, it tilts at ten degrees past the perpendicular!

For good measure, the riders get an unexpected thrill on the way to the top of the incline, before the coast. Hauled through an unlighted tunnel, the train suddenly stops in a pitch-dark "illusion barrel" fifty feet long and ten feet in diameter. The track starts to vibrate. Glowing spots of light, appearing on the walls of the barrel, start revolving slowly about the train. The darkness echoes with squeals and screams, for the passengers receive the terrifying impression that the cars themselves are turning over and over in space. The illusion lasts for twelve to fifteen seconds, which its inventor believes is about as long as human nature can take it, before the train proceeds. So that there will be no telltale shafts of light from projectors, the mysterious glowing spots are produced by throwing invisible ultra-violet beams upon the walls of the barrel, which are coated with fluorescent paint that glows in the rays.

For even more venturesome thrill seekers, the tallest parachuting tower in the world rises to the height of a twenty-five-story building at the southern end of the fair grounds. Like puppets on strings, eleven gayly colored captive parachutes dangle on cables from its uppermost girders. Beneath each 'chute swings a double seat, in which a pair of passengers are strapped at the ground. Then the giddy ascent begins. The riders will enjoy the finest view of the fair available to visitors, if they can keep their minds off what


A "MARTIAN" AND ONE OF HIS WEAPONS
BOARDING THE ROCKET SHIP FOR AN IMAGIN
ROCKET-SHIP PASSENGERS VIEW SCENES ON PLANET VENUS
MOTION PICTURES ON CIRCULAR WINDOW DEPICT FLIGHT THROUGH SPACE
VIBRATING SEATS ADD TO THE ILLUSION OF MOTION
"MARTIAN HEADQUARTERS" PRESENTS ANIMATED "FLASH GORDON" ADVENTURES

HERE IS A PREVIEW OF THE COLORFUL AMUSEMENT ZONE WHERE INGENIOUS NEW RIDES AND COLOSSAL SPECTACLES WILL AWAIT VISITORS TO THE NEW YORK WORLD'S FAIR

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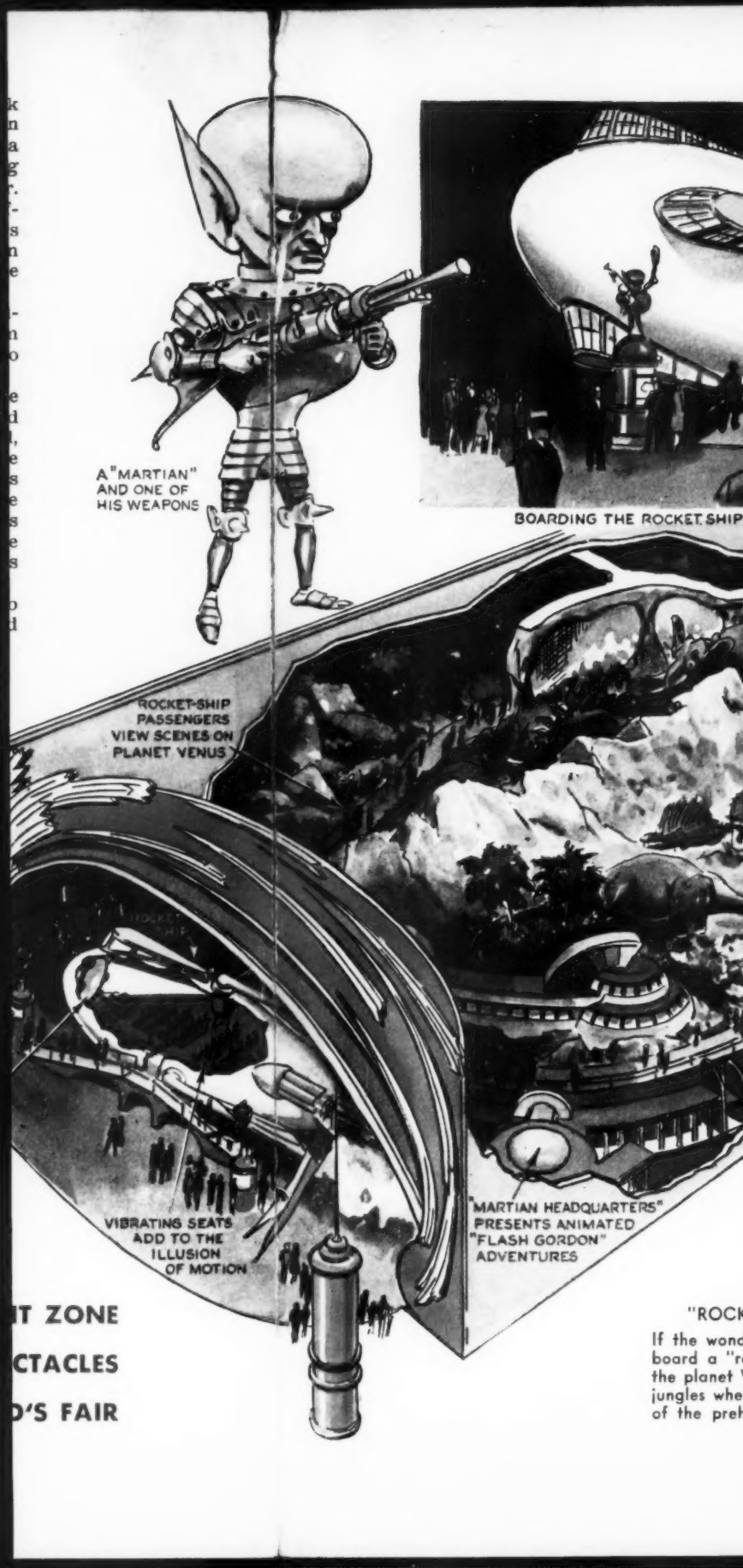
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ROCKET SHIP FOR AN IMAGINARY TRIP TO VENUS

Drawings by
B. G. SEIELSTAD

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"ROCKET SHIP" TAKES PASSENGERS TO VENUS

If the wonders of the earth aren't enough for you, you can board a "rocket ship" for a realistic fling through space to the planet Venus. On your arrival, you walk through primeval jungles where you see animated models of animals like those of the prehistoric earth, and a colony of weird "Martians"

is going to happen to them next. For at the top of the 250-foot tower, an automatic release drops parachute and passengers into thin air. Though the feeling is akin to bailing out of an airplane, the "jump" has been safeguarded against the slightest hazard. A metal ring keeps the parachute open at all times, vertical guide wires prevent it from swaying or drifting in the wind, and shock absorbers

INFORMATION BOOTH
ENTRANCE RAMP TO MODEL OF FALLS
SPECTATORS VIEW FALLS FROM PATHS THROUGH TROPICAL RAIN FOREST
LOUVERS ADMIT DAYLIGHT AND AIR
WIRE SCREEN KEEPS BIRDS AND ANIMALS AWAY FROM SPECTATORS
PROJECTORS FOR CLOUD EFFECTS
FEED CANAL
FALLS
TREES DECREASE IN SIZE TOWARD FALLS TO GIVE PERSPECTIVE EFFECT OF DISTANCE
PUMP INTAKE

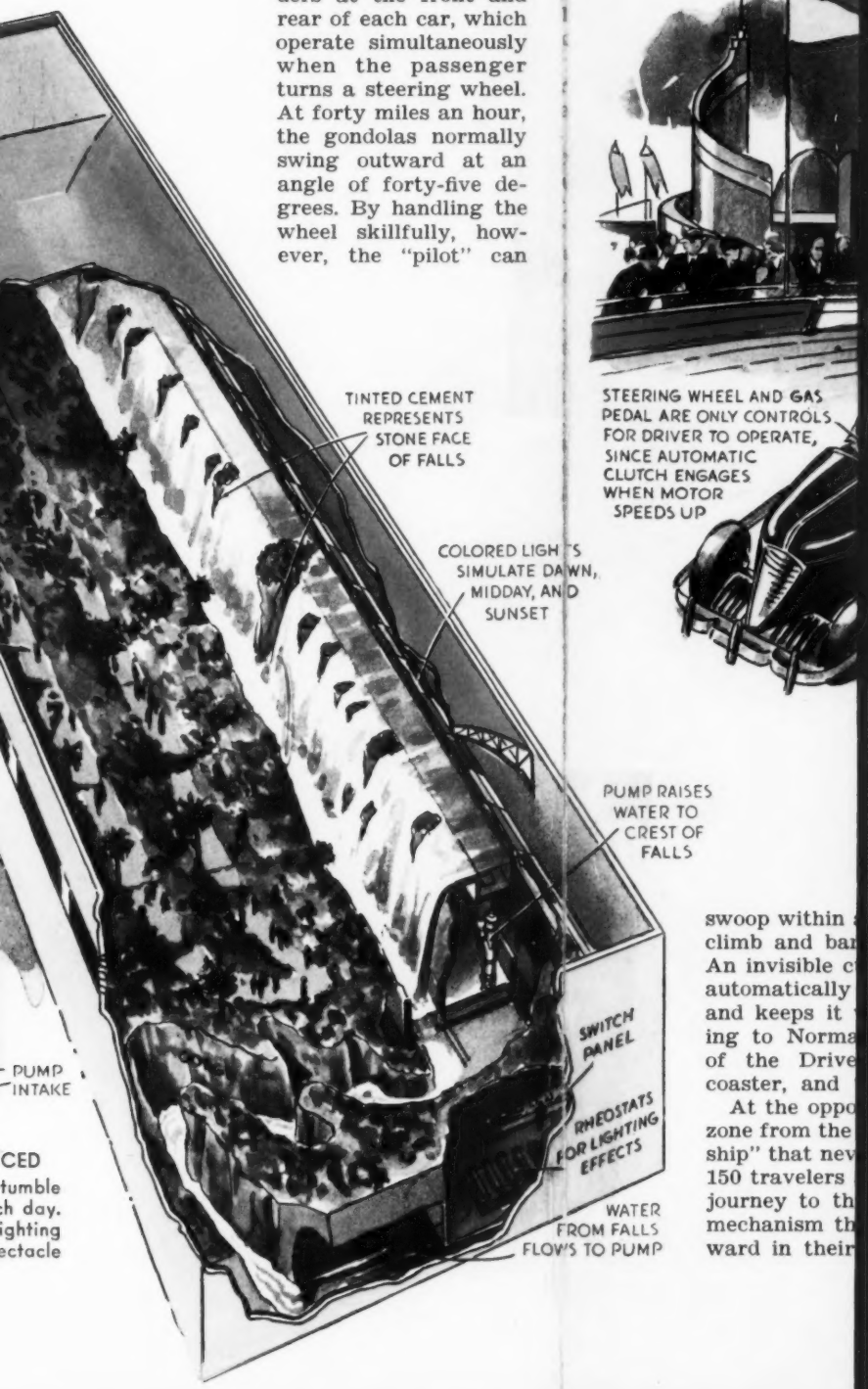
ONE OF NATURE'S WONDERS REPRODUCED

Enough water to float the "Queen Mary" will tumble over the brink of a model of Victoria Falls each day. A realistic African setting and elaborate lighting effects will add to the illusion of the spectacle

at the bottom all but eliminate the jolt of landing.

An aerial joy ride not far away provides captive "planes" for aviation enthusiasts to fly. Sixteen streamline gondolas, hung on cables from a revolving ring, circle around its supporting tower of structural steel. An innovation that distinguishes it from all other such devices is a pair of rudders at the front and rear of each car, which operate simultaneously when the passenger turns a steering wheel. At forty miles an hour, the gondolas normally swing outward at an angle of forty-five degrees. By handling the wheel skillfully, however, the "pilot" can swoop within a climb and bar An invisible c automatically and keeps it ing to Norma of the Drive coaster, and

At the oppo zone from the ship" that nev 150 travelers journey to th mechanism th ward in their


GUIDE RAILS DEFLECT CARS FROM BANKED SECTION AT END OF RIDE
STEERING WHEEL AND GAS PEDAL ARE ONLY CONTROLS FOR DRIVER TO OPERATE, SINCE AUTOMATIC CLUTCH ENGAGES WHEN MOTOR SPEEDS UP
TINTED CEMENT REPRESENTS STONE FACE OF FALLS
COLORED LIGHTS SIMULATE DAWN, MIDDAY, AND SUNSET
PUMP RAISES WATER TO CREST OF FALLS
SWITCH PANEL
RHEOSTATS FOR LIGHTING EFFECTS
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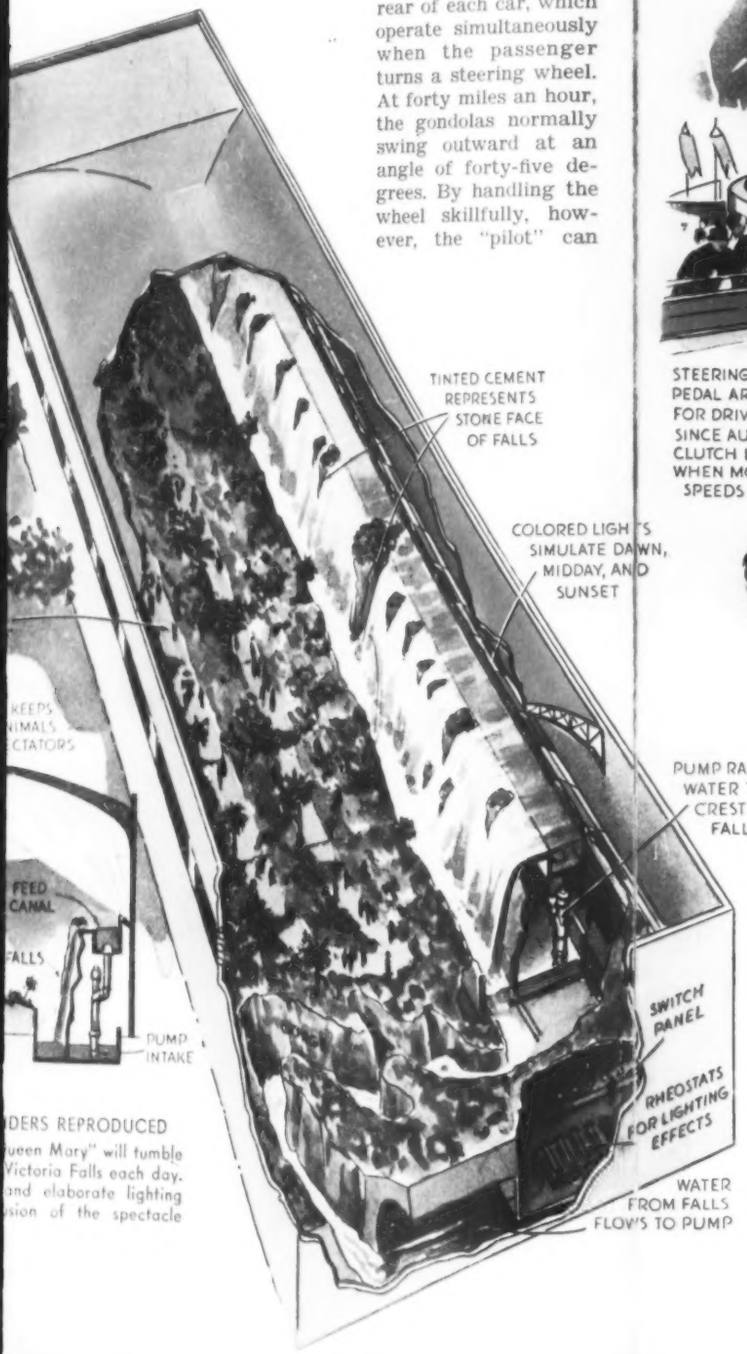
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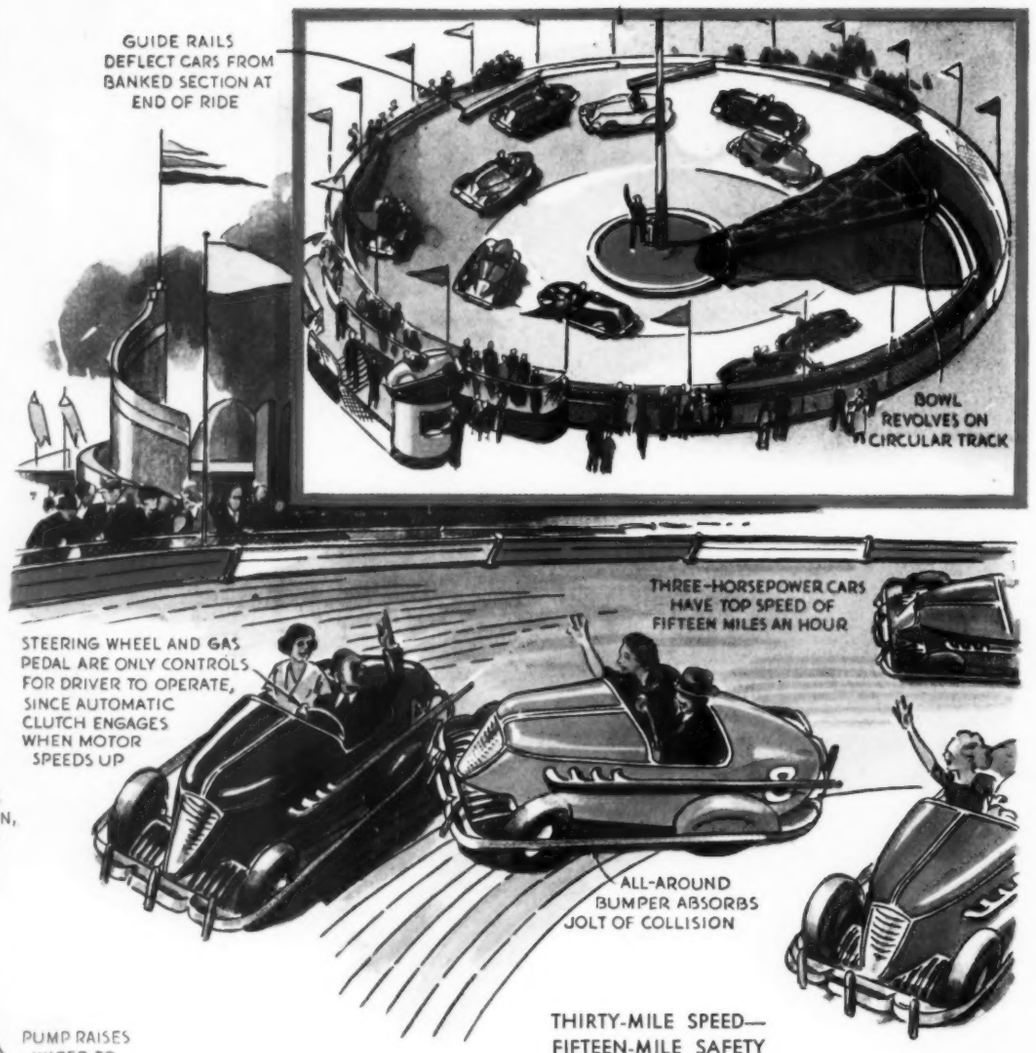

GUIDE RAILS DEFLECT CARS FROM BANKED SECTION AT END OF RIDE
BOWL REVOLVES ON CIRCULAR TRACK
THREE-HORSEPOWER CARS HAVE TOP SPEED OF FIFTEEN MILES AN HOUR
STEERING WHEEL AND GAS PEDAL ARE ONLY CONTROLS FOR DRIVER TO OPERATE, SINCE AUTOMATIC CLUTCH ENGAGES WHEN MOTOR SPEEDS UP
ALL-AROUND BUMPER ABSORBS JOLT OF COLLISION
THIRTY-MILE SPEED— FIFTEEN-MILE SAFETY

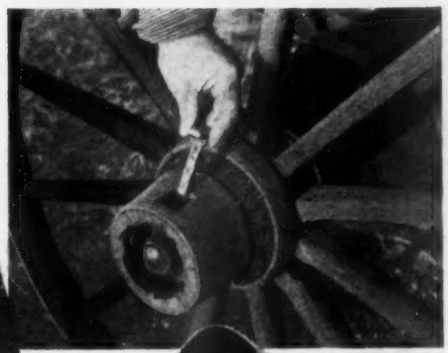
Driven by thrill hunters, these miniature racing cars bump one another with perfect safety, because they are actually going only fifteen miles an hour on a circular track that revolves to give an impression of speed

swoop within a few feet of the ground or climb and bank past the perpendicular. An invisible cushion of centrifugal force automatically checks the sideward swing and keeps it within safe limits, according to Norman Bartlett, the originator of the Drive-A-Drome, the "bobsled" coaster, and this pilot-yourself thriller.

At the opposite end of the amusement zone from the parachute tower, a "rocket ship" that never leaves the ground, takes 150 travelers at a time on an imaginary journey to the planet Venus. A hidden mechanism throws the passengers backward in their seats as if the ship were actually taking off, and motion pictures projected upon a circular "window" show the fair grounds dropping away. Blasts from air jets, movies of stars passing the window, and the constantly vibrating seats enhance the dramatic effect of the supposed trip through space.

When the craft has "landed," a passenger alights from a door opposite the rocket ship's entrance to find himself in a world of fantasy. Venus is portrayed as a planet still in a primeval state, colonized by space-voyaging Martians and roamed by animals like the earth's prehistoric mon- *(Continued on page 242)*

One of the covered wagons that Bryant Mitchell, of Hudson, Ohio, rents for use in parades or fairs



Mitchell putting up ribs that support a wagon top. Upper right, inserting an axle pin. Oxen pull the wagons in parades, as seen at right

Do You Want To Hire a Prairie Schooner?

COVERED wagons ranging in age from 116 to 120 years form the basis of an unusual business run by Bryant Mitchell, of Hudson, Ohio. He rents the historic vehicles to organizations and individuals for use in parades, advertising stunts, carnivals, fairs, and the like. He can furnish oxen for use with the wagons, if his customers desire them. The wagons have been used to give novelty rides, at ten cents a person for a 500-foot journey, for people who want to be able to say that they have ridden in a covered wagon.

At present, Mitchell has two covered wagons in running order, one a small family vehicle and the other a larger freight-carrying wagon. Although they were built as far back as 1818, one in Vermont and the other in California, most of the original oak wood and hand-wrought ironwork remains. The wheels turn on wooden axles reënforced with iron, and are held in position by iron pins passing through transverse holes near the axle ends, as illustrated in one of the photographs on this page.

Walking Fish Strut Their Stuff

DID you ever see a fish walking? Well, the people pictured above did, as William J. Connelly, of Parma, Ohio, displayed two of the rare Chinese walking fish which he brought to New York when he recently made a radio appearance on a hobby program. The fish raced each other along a wooden trough, moving forward by using their fins, much as seals use their flippers.

Kiddie's Dish Won't Upset

TO PREVENT a baby from tipping it over, a new feeding dish for infants is fitted with rubber suction cups on the bottom. The cups will adhere to any smooth surface and may be unscrewed and replaced with new ones. Two models are available, one made of stainless steel and the other of a plastic material with three separate compartments.

Suction cups on the bottom of the dish cling to any smooth surface, as illustrated above

Soap Spray Cleans Automobile Parts

ADDED to water or some other solvent, a new soap preparation cleans metals and is specially designed for automobile-motor and chassis work. A sprayer designed for the purpose spreads the soap preparation, which is left on for a period of about ten or fifteen minutes to allow it to penetrate into accumulated grime, grease, and dirt. The surface is then washed off with a pressure rinse from a water hose. This is said to remove oil, grease, and other matter without harming the metal or covering coats of paint.

Metal-cleaning soap preparation being sprayed onto an auto engine

Photograph Samples To Protect Buyers

TO ASSURE buyers that the articles they order will be similar to the samples shown them, salesmen are now using a novel portable photographic outfit just introduced. When a sale is made, the sample is placed on a miniature stage within the metal unit, four inclosed floodlamps are switched on, and the shutter of a built-in camera snapped. When the film is developed, the buyer is given a permanent photographic record of the sample for comparison with the items when delivered.

In this portable studio, samples are snapped for identification

Electric Eyelash Curler

WHILE ironing out the wrinkles in the faces of customers, beauty shops equipped with a new electric device can put a curl in their eyelashes as well. The unit consists of a tiny clamp that snaps onto the eyelashes. An electric heating element sets curls in the lashes.

Setting-Up Exercises Are Taken Lying Down

SETTING-UP exercises are taken lying down, on an adjustable exercising couch invented by Raymond Strawn of Los Angeles, Calif. Supported on tubular steel legs, the novel bed has a back which can be raised or lowered at will, and a padded cylinder at the foot for hooking the toes under when necessary.

Exercising couch in use. Note the adjustable back and handy toe hold

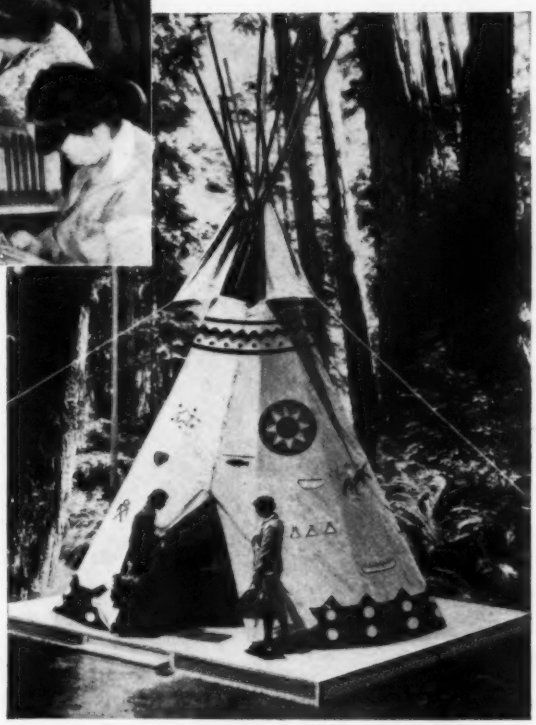
Reader Amuses American Cigar Workers

It's an old Spanish custom, now adopted in America

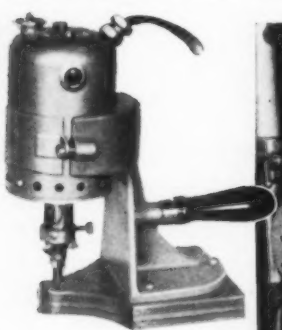
TO HELP relieve the monotony of their tasks, women workers in a New York City cigar factory have adopted a plan commonly employed abroad. Each worker pays twenty-five cents a week to hire a man who reads aloud to them as they work, selecting items from Spanish and English newspapers for the purpose.

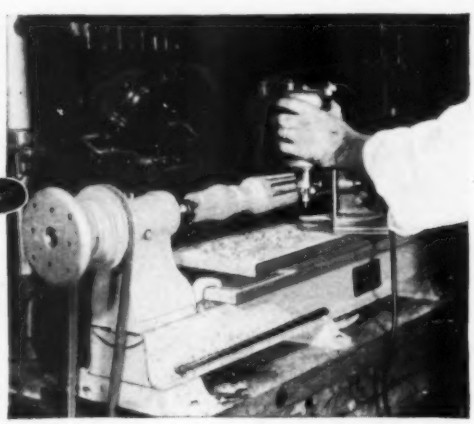
Fair Visitors Go Native in Tepee Tourist Cabins

INDIAN tepees will be built along main highways in the West to serve as colorful overnight cabins for visitors motoring to the Golden Gate Exposition at San Francisco, Calif. Pitched on raised wooden floors, tepees will accommodate from four to six persons each. The tent cabins are fitted with smoke holes at the top, which can be closed during rainy weather, when flaps in the sides serve to ventilate the interior. Several tepee villages will provide accommodations near the site of the fair.



Tourist squaws inspecting one of the tepee cabins



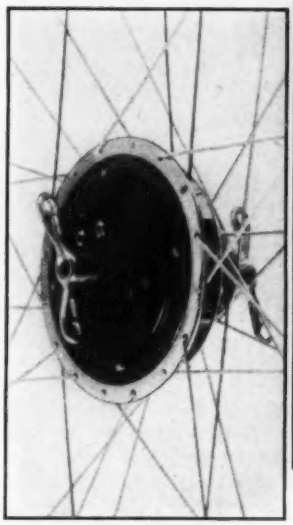


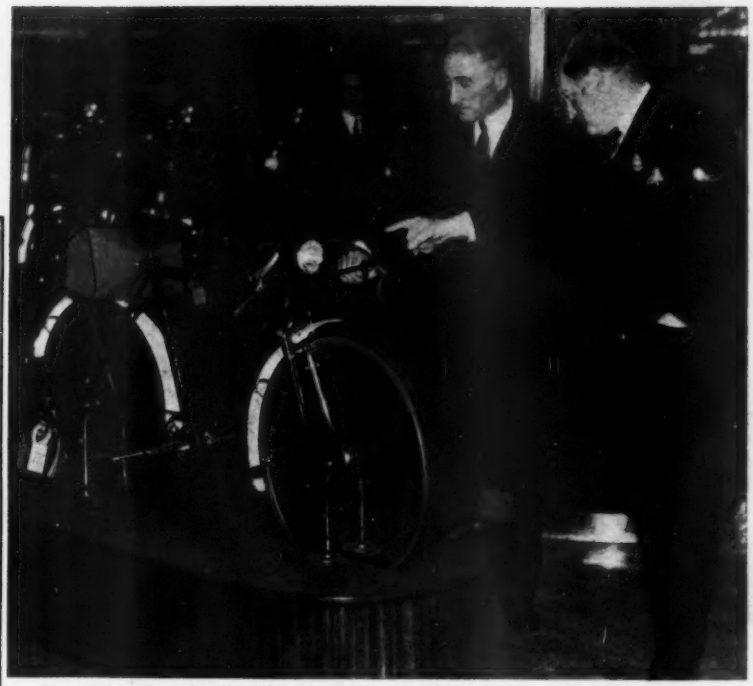
Work can be held in a lathe, as at right, in using this handy tool

Beading Machine for Hobbyists Is Easy to Use

BEADING and fluting of woodwork are easily accomplished with a new electric tool just introduced for home-workshop enthusiasts. Designed especially for use on work held in a lathe, the machine is operated as shown at the left.

Wheel Hub Has Dynamo To Light Bike's Headlamp





Electricity for the headlamp of this British bicycle is furnished by a "frictionless" dynamo in a dustproof housing in the front hub, at left

BUILT into the front wheel of a new British bicycle, a "frictionless" dynamo lights the headlamp with a minimum of effort. A ring-shaped magnet, the only moving part, turns with the wheel about the stationary armature in the hub. Use of a powerful new magnetic alloy removes the need to gear it up to many times this speed, and there are no brushes, slip rings, or separate bearings to create friction.

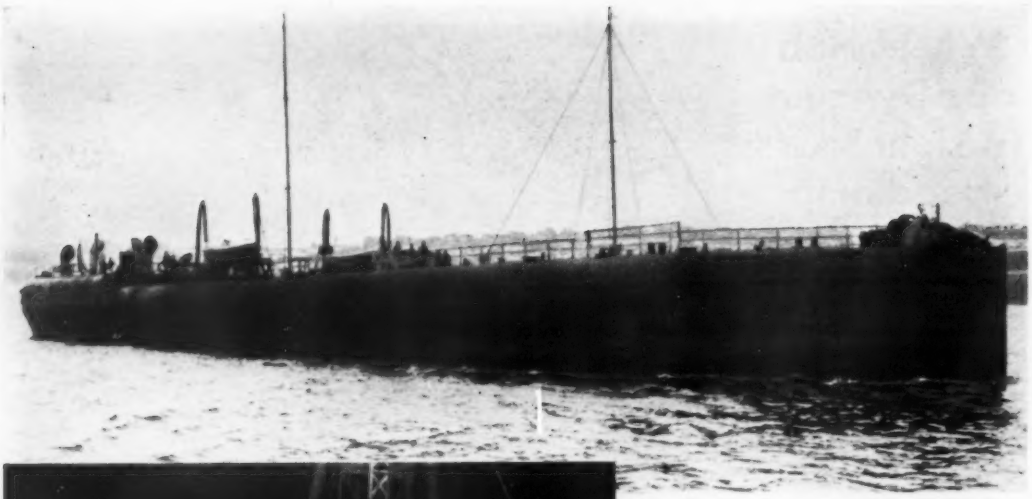
Nonskid weenie roll and mold in which it is made

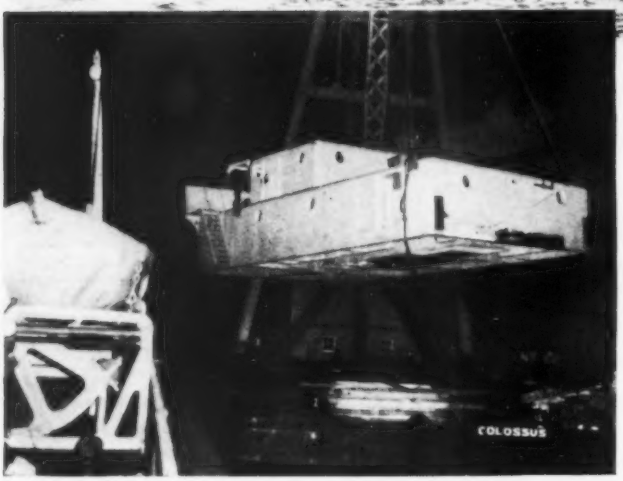
Nonskid Roll for Hot Dog Grips Wandering Weenie

AT LAST America has it—the nonskid roll for hot dogs! A clever inventor has devised the metal mold shown at left to turn out rolls imprinted with a series of ridges. They take a masterful grip upon the delectable but elusive weenie and prevent it from slipping from its rightful place to fall to the floor or one's lap.

Sportsmen Get Eye Shield

HINGED to a lightweight headgear, a transparent eye shield of new design affords unobstructed vision for motorists and sportsmen. Obtainable in clear or colored shades, the flexible visor gives protection from wind or sun, while providing ample ventilation that eliminates fogging.





Removable deck house being placed on the all-welded freighter "Dolomite 4." The novel craft is seen in the upper photograph

Welded Freighter Is Nickel-Lined

SET AFLOAT without a launching, the nickel-lined, all-welded freighter *Dolomite 4* sets precedents. Artisans built it in an abandoned canal lock (P.S.M., Oct. '38, p. 106), admitting water and opening the lock gates to float the 300-foot vessel into the New York State Barge Canal. Sixteen-gauge sheet nickel shields its holds from caustic soda and other highly corrosive chemicals it will carry. It has neither rivets nor ribs, and a removable deck house makes it convertible to a canal cargo carrier.

Film Stars' Photos Printed on Pillows

NOT CONTENT with collecting photographs and autographs, star-struck movie fans in England go their American sisters one better by buying novelty pillow covers bearing the likenesses of their favorite movie stars. Almost life size, the pillow portraits are real photographs printed on the fabric by a photographic-printing process. The material is first treated with a sensitizing solution, then exposed under the negative, and finally developed and fixed. Movie-star draperies, upholstery, and dress fabrics are being manufactured in a similar way.

The picture is reproduced on cloth by a special photographic process

Home Unit Extracts Vegetable Juices

The grinder fills the cloth bag with chopped vegetables, and a hand press extracts the juices

A NEW electric juice extractor makes it easy to prepare fresh-vegetable juices of every description at home. When carrots, beets, celery, spinach, fruits, and berries are fed into its motor-powered shredder, they are instantly reduced to pulp. Collected in cloth bags, the product is said to yield all its vitamins, minerals, and other valuable nutritive elements in a powerful hand press, where tons of pressure exerted by means of a convenient lever squeeze out every drop of juice and leave only a bone-dry residue behind in the bag.

Earl Gresh at a woodworking bench in his own plant

Depression Turned Hobby into a Big Business

UNDISMAYED when the depression hit the entertainment field a few years ago, Earl Gresh, former orchestra leader, proved his resourcefulness by turning for a new career to his hobby of creating artistic novelties from wood. He tried making women's purses from polished woods, and found the idea caught on. Now he has the fastest-growing pay roll in St. Petersburg, Fla., and his factory turns out a variety of products that include wooden animals, dress trimmings, bracelets, lamp tables, serving trays, and dinner favors.

Colds Prevent Fatal Ills

GERM-FIGHTING white blood cells present in the noses of sufferers from "sniffy" winter colds may be a protection against infantile paralysis, sleeping sickness, and influenza, according to the U. S. National Institute of Health. Mice infected with cold germs have proven less susceptible to the fatal viruses.

Francis E. Wilkinson at work in the laboratory in which he harnesses high-frequency electricity to change one substance into another

In tubes like these, equipped with coils carrying high-frequency current, raw materials turn into strange new products for industrial use

Back-Yard Alchemist

CREATES NEW SUBSTANCES WITH HIGH-FREQUENCY ELECTRICITY

DANCING electrons, whipped to a jitterbug frenzy, are performing miracles of modern alchemy in a back-yard laboratory at Glendale, Calif. Racing back and forth through coils of wire at frequencies up to 100,000,000 cycles or vibrations a second, they transform water, natural gas, cottonseed waste, and potato peelings into new and useful substances for industry.

At a blackened and scarred workbench covered with odds and ends of equipment picked up in junk shops, Francis E. Wilkinson sees matter undergoing strange, sometimes incomprehensible changes. What his wizardry produces, not even he always knows. Yet the pulsing electrons already have created an entirely new, potent motor fuel from cottonseed waste, alcohol from water and natural gas, synthetic rubber from vegetable residue.

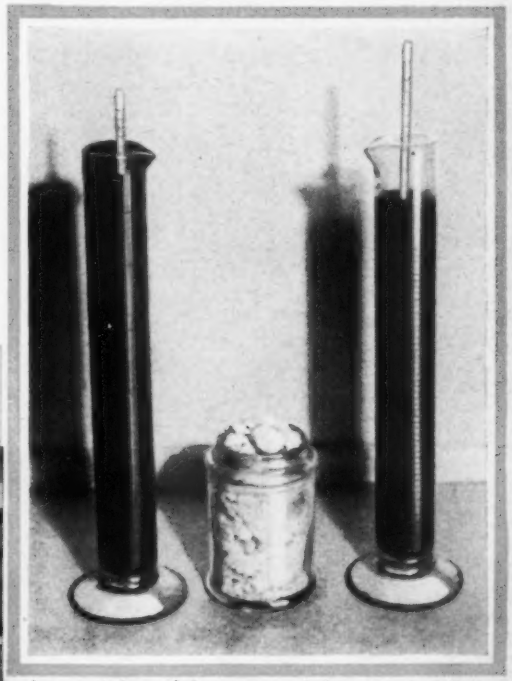
Where this modern alchemist's researches will lead, even he cannot guess. He is bringing to bear on waste materials a new force, about which science knows little. How will high frequency affect industry? "Go back a few years," he suggests, "and consider how little man knew about heat. Water boils at 212 degrees. With what electrical frequency can heavy crude oil be transmuted into another, more valuable creation? When we know that simple fact about various substances, we will have the beginnings of many new industries."

Wilkinson began his researches as a student at London University, in England. Later he came to the United States and settled in California, where for two decades he has worked as a consulting engineer and experimented in his crowded little laboratory. Unbreakable glass tubes, each wound to create a particular electrical frequency; spark gaps made from burned-out light bulbs; a galvanometer employing Christmas-tree tinsel—these are his principal tools.

Tall, spare, easy-going, Wilkinson works methodically to achieve results the full effect of which may not be felt for another generation. He deals with frequencies which stagger the imagination. Your radio programs flow through the air on frequencies in the 500,000–1,500,000 range. This man has knocked carbon out of natural gas with an 80,000,000 frequency. Just as easily, he treats walnut oil with 100,000,000.

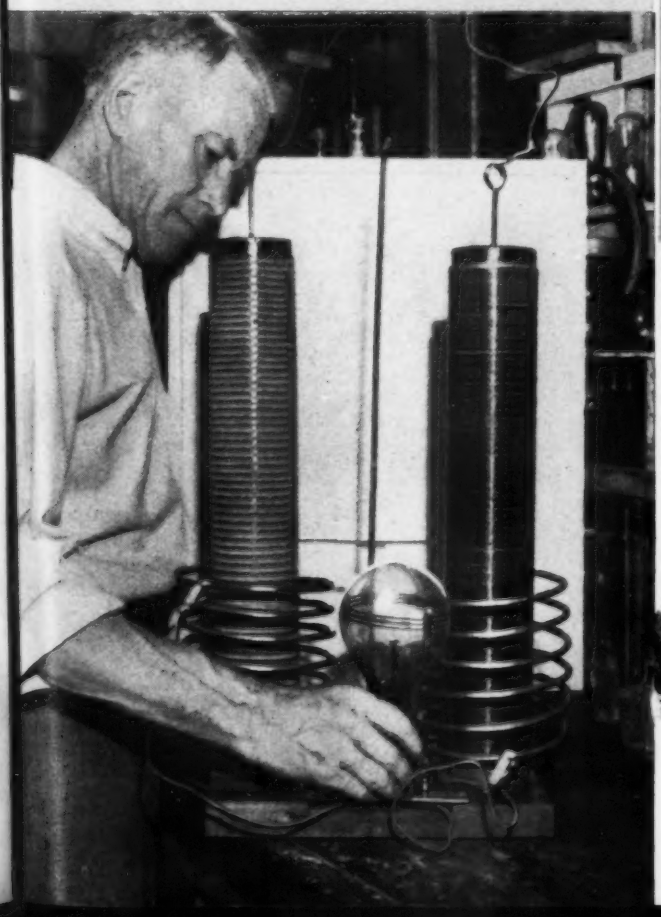
Three years ago he thought he was beginning to plumb a few secrets of the effects of electricity upon matter. About that time he turned his attention to round-the-world airplane flights. "Since petroleum products are not easily available in all countries," he reasoned, "the world must have a universal motor fuel, one easily manufactured anywhere."

He went to work to find a motor fuel

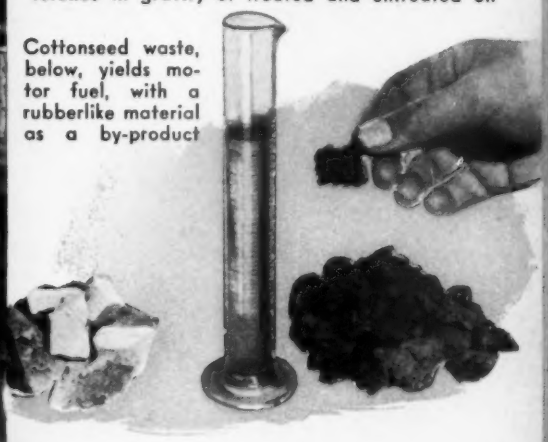


Jar contains sulphur removed from crude oil by high-frequency treatment. Hydrometers show difference in gravity of treated and untreated oil

Below are the coils that create the high frequencies used by Wilkinson in his experiments. A burned-out light bulb, wound to set up a magnetic field, serves as a spark gap



Cottonseed waste, below, yields motor fuel, with a rubberlike material as a by-product



which could be created from fruits or vegetables. He treated decayed fruit with electricity, produced both alcohol and lubricants. Then he discovered that by adding products obtained from sour cottonseed oil to the alcohol, he had an efficient motor fuel. For good measure, among the by-products was a material which looks, smells, and bounces like crude rubber. He submitted several pieces to a Los Angeles laboratory, and in a few days received a sheet of refined rubber.

"Decayed vegetables will supply the alcohol," he told me. "Alcohol may be easily combined with the carbon radical from other oils, gums, and resins by high-frequency treatment. Thus motorists and airplane pilots need not depend upon oil wells for their fuel."

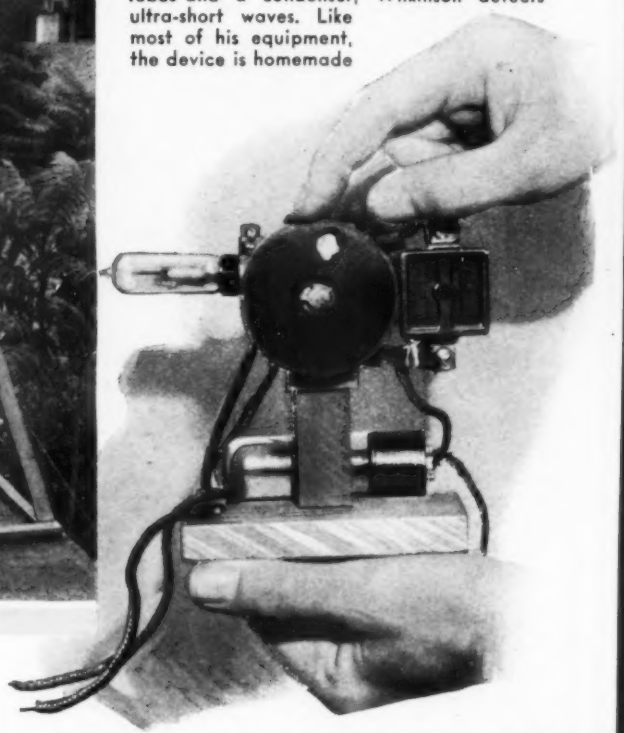
Five years Wilkinson labored, pouring streams of high-frequency "juice" through waste natural gas and tap water. Eventually he hit the proper combination, and got alcohol. Now he's using gas rich in hydrocarbons in an effort to achieve a high-grade alcohol, one which will provide the basis for a high-test motor fuel.

So with old newspapers—"that's wood, you know"—and dried potato peelings, rich in starch and several other useful chemicals. He showed me a jar containing a messy paste. It smelled like fragrant wild flowers. "Perhaps," he hazarded, "waste paper one day will provide power for our engines."

On the day of my visit, Wilkinson was answering a hurry-up call from an oil company to find some way of making a sulphur-laden crude fit for use. For two hours he submitted a container of natural gas to an electronic bombardment, 80,000,000 a second. Then he passed the gas through the black crude, which was itself undergoing a 150,000,000-frequency treatment. Finally he added salt water to the oil, settled out the water, evaporated the liquid. By "busting" the sulphur compound, he drove free sulphur into the water and recovered it

Power transmitted without wires, by this weird-looking apparatus, is picked up by the screen at rear to light a neon lamp

With the instrument below, consisting of two tubes and a condenser, Wilkinson detects ultra-short waves. Like most of his equipment, the device is homemade



• JITTERBUG ELECTRONS SERVE A MODERN ALADDIN

as a small pile of gleaming yellow brimstone. In a half day he changed unusable crude into a lower-gravity oil which could be easily refined.

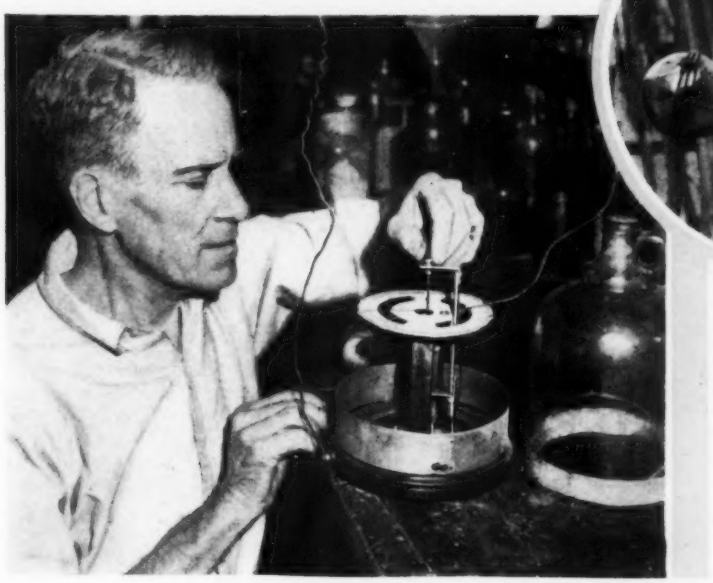
Standing beside Wilkinson, you can see matter actually change under the electronic bombardment. It looks very simple, yet the process represents a lifetime of cut-and-try experiments. Two tall coils generate the high frequencies. The burned filaments in discarded light bulbs which have been wound with small wire to create a magnetic field, serve as spark gaps. High-frequency currents from this apparatus pulse through the coils of the tubular vessels in which he treats his raw materials.

Peculiar discoveries attend his researches. For one experiment, he placed a copper electrode in a flask through which high-frequency current was conducted to a liquid. The liquid vaporized and passed through a second flask into a graduate, where it condensed. A quantity of metallic copper collected at the bottom. No heat had been generated, yet somehow the metal was transmuted through vapor and condensed again. On another occasion, he distilled and treated a quantity of carbon tetrachloride, which ordinarily will not burn. Yet after bombarding it with ultra-short waves, it became highly inflammable. Why? Wilkinson cannot say.

When you approach the little back-yard laboratory, almost hidden among large clusters of bamboo, you see on the roof a large window screen, and a pair of copper floats fastened to the ends of a slanting rod. The rod serves as a transmitter, and the screen, thirty-six inches away, as a receiver. With this set-up, he has transmitted enough power through the air to light a neon lamp in the room below.

This back-yard experimenter labors without pay because he hates war, and hopes that his experiments may help provide enough raw materials for the world so that nations will cease going to war over them.

Ground potato peelings may prove a profitable source of starch and other valuable chemicals

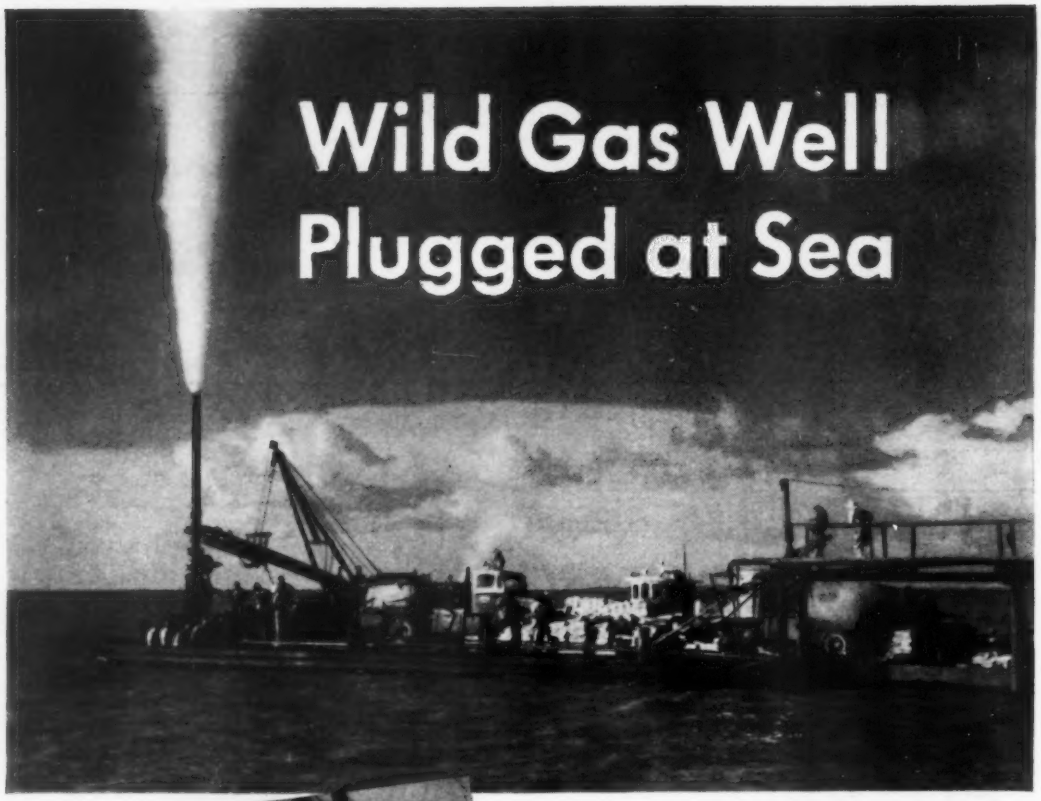


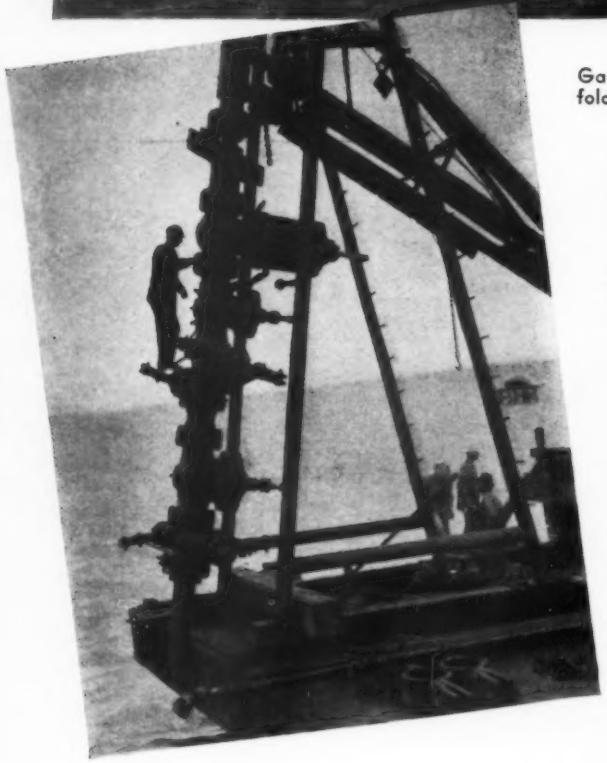
Here are two of Wilkinson's light-bulb spark gaps. Wire wound around the glass provides an electrical field

An old magnet, a spool, a coil of wire, and a Christmas-tree tinsel form this galvanometer to detect small currents

IN THE LABORATORY OF FRANCIS E. WILKINSON •

Wild Gas Well Plugged at Sea





Gas roaring through the stack of the huge manifold, seen at the left being tested before use

BELCHING 250,000,000 cubic feet of natural gas a day through the waters of Vermilion Bay, on the coast of Louisiana, a runaway gas well recently gave professional wild-well fighters one of the toughest battles in the history of their dangerous occupation. Before they finally succeeded in stemming the rebellious flow after a forty-five-day fight, their machinery had been wrecked, two men had been killed, and a third had lost an arm. Photographs on these pages show various stages of the dramatic contest.

While drill pipe was being pulled out of an oil well being sunk in the bottom of the bay, sand and gas suddenly began to blow up through the 9,667-foot hole. Soon enough gas to supply a city of 1,000,000 inhabitants was spewing up through the water, with a roar that could be heard as far as Avery Island, twenty-two miles away.

From Houston, Tex., H. L. Patton and his crew of dare-devil wild-well fighters were called—men whose work it is to

By
JOHN E.
LODGE

•

tame the runaway gassers. Assembling a capping manifold that weighed more than eight automobiles, they towed their ponderous equipment out to the well. As the first step in bringing the gas under control, they removed the barge supporting the drilling derrick. Placing their huge manifold over the well outlet, they fastened it down to the casing with chains and started closing the two valves to stop the flow of gas.

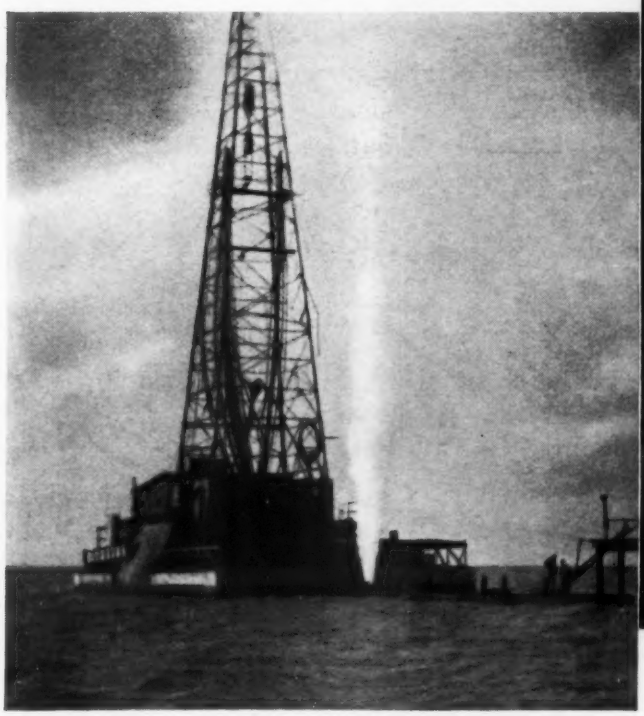
With a blast like the discharge of a cannon, the tremendous force burst the chains and the gas roared free—now on fire. Two men were killed by the explosion, and Patton was carried to the hospital with his right arm blown off at the shoulder.

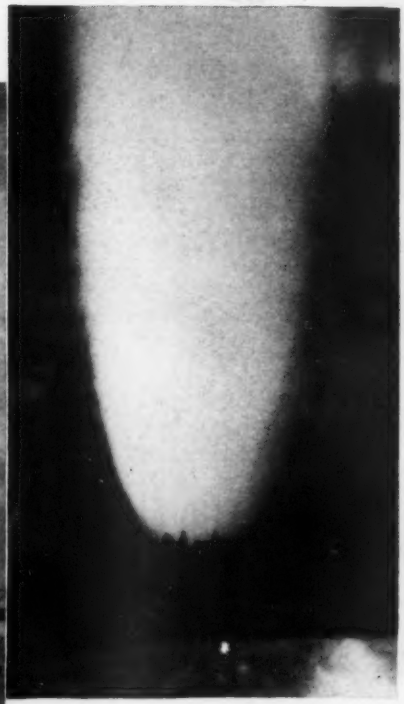
Undaunted by this disaster, the crew moved back into action with their heavy equipment. Again the manifold was clamped over the well casing and the valves were closed. This time the chains held. The flames were checked, and 200 tons of mud were pumped down into the hole.

Then, like a fleet of battle-scarred warships, the bargeloads of wrecked machinery were towed away across the inlet to Avery Island, there to be rebuilt for further struggles with the runaway forces of nature.

Wrecked by the explosion, the heavy equipment is towed away to be rebuilt

Below, the drilling derrick, battered by the pressure of the gas, is being removed to make way for the wild-well fighters

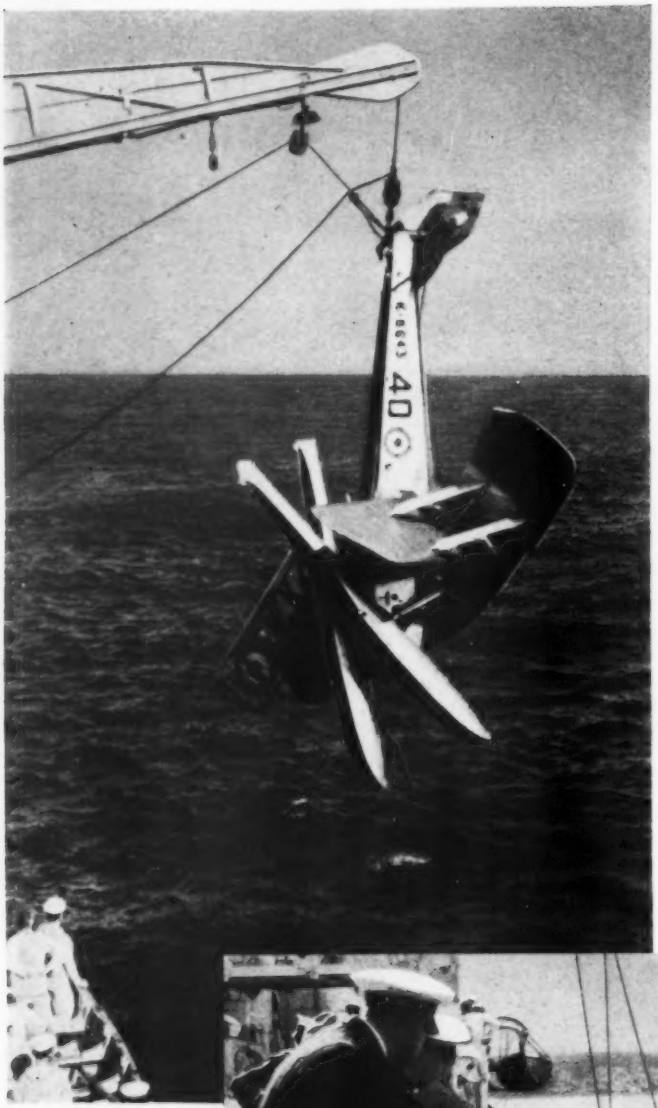




This is how the well looked before the derrick was removed. The flow of gas reached 250,000,000 cubic feet a day

Salvaging Radio Targets

PILOTLESS planes, controlled by radio and used as targets by British antiaircraft gunners, sometimes get hit. Photographs on this page show what happens to the remains. Hastening to the spot where the disabled craft dived into the water, the "mother ship" from which it was operated hauls out the wreckage with a crane and deposits it on the deck of a barge for inspection to see what can be salvaged. Often the expensive, precision-control mechanism that makes these "Queen Bee" planes marvels of automatic piloting can be recovered. The motor and other standard plane parts are so much added booty. If the plane escapes the gunners, it returns and alights under radio control beside the mother ship, to be refueled and made ready for another trip.

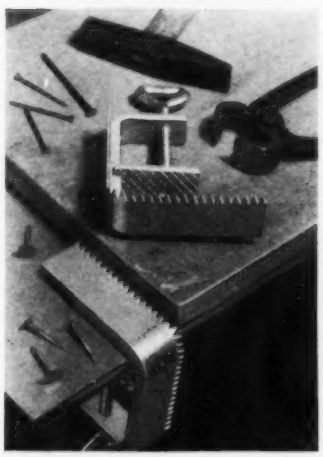


The plane, shot down in target practice, is lifted from water

Placed on a barge, the plane is inspected. If it cannot be repaired, parts are salvaged

X-Ray "Candid Camera" Takes Snapshots

CALLED ten times faster than conventional X-ray machines, the new 1½-ton photographic model shown above has been developed by Westinghouse engineers for diagnosing ailments. It takes "snapshots" speedy enough to "stop" the motion of heart and lungs, even if a patient's pulse rate exceeds 200 beats a minute. An X-ray tube with a novel spinning target produces the intense X-ray beam that makes this possible.



Clamps Make Any Table a Workbench

ANY good-size table becomes a workbench for planing and other operations, when a pair of handy new clamps are used to hold the work in place. Sharp teeth engage a board when a clamp is tapped against each end, and the clamps are then made fast to the table top with thumbscrews.

Clip Keeps Keys Handy

FASTENING securely to the pocket of a woman's handbag, a new clip holds keys where they may be reached without fumbling through a scrambled miscellany of belongings. The handy clip can also be attached to a man's pocket, brief case, or belt.

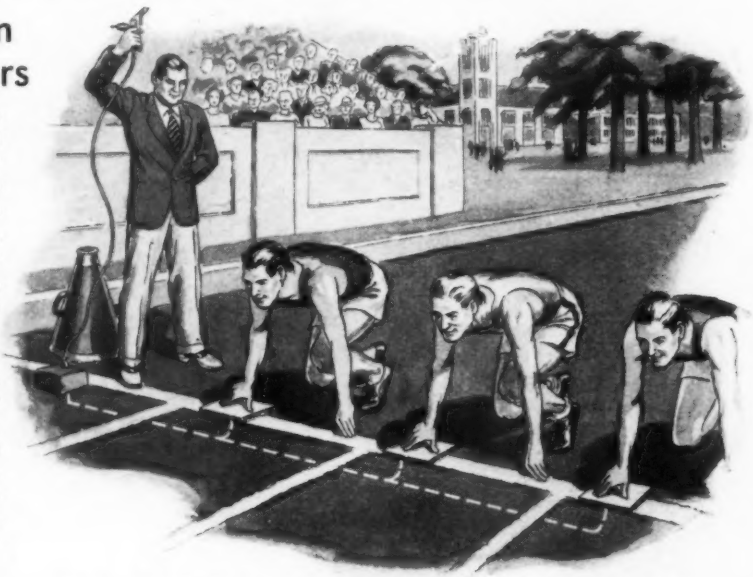
Portable television receiver with its screen tilted at best viewing angle

Extension Television Receiver

LIKE extension telephones, portable television receivers, which have just been put on the market, can be used in any part of a home. Each of the extension receivers has its own cathode-ray tube and lens for magnifying the image, which is originally picked up by a central receiving set. In addition to being portable, the new receivers are pivoted so the screen angle can be adjusted.

Electrical System Balks Gun Jumpers

RUNNERS cannot jump the gun at track meets when an ingenious new electric starting system is used. As shown at the right, each runner rests a hand on a pad set in the ground as he gets set at the mark. The pads are electrically wired to the starting gun so that the pistol will fire only if each runner's hand is pressing the pad in front of him. If a contestant lifts his hand prematurely, the circuit is broken and the starting signal cannot be given, thus assuring that no runner gets under way ahead of his opponents.



If a runner lifts his hand prematurely, the starter's gun will not fire

This three-power sports glass weighs only six ounces

Vest-Pocket Binoculars

COMPACTNESS and light weight are outstanding features of vest-pocket sports binoculars recently introduced. Tipping the scales at only six ounces, the three-power glass is designed to provide a wide horizontal field of vision. At a distance of 1,000 yards, the binoculars cover an optical field 452 feet wide. A leather case is provided with the unit.

Sickroom Hobby Brings Wealth

MISFORTUNE brought Gertrud Bertilson, of New York City, good luck. Last year, illness interfered with her work as a sculptress. While she was convalescing, with time hanging heavy on her hands, she put her mind to work. The result is a new form of art—wool sculpture—which is bringing her wealth as well as wide attention. Instead of using conventional clay for modeling, she creates her figures from varicolored bits of wool. They range from Don Quixote and other characters from the pages of classic fiction, to Scandinavian peasants in colorful costume. Each figure brings her from ten to sixty-five dollars and she is selling her novel "sculptures" as fast as she can turn them out. A group of her creations is shown in the accompanying illustrations.

Don Quixote and Sancho Panza ride out of Cervantes's pages in this group sculptured from wool yarn by Gertrud Bertilson

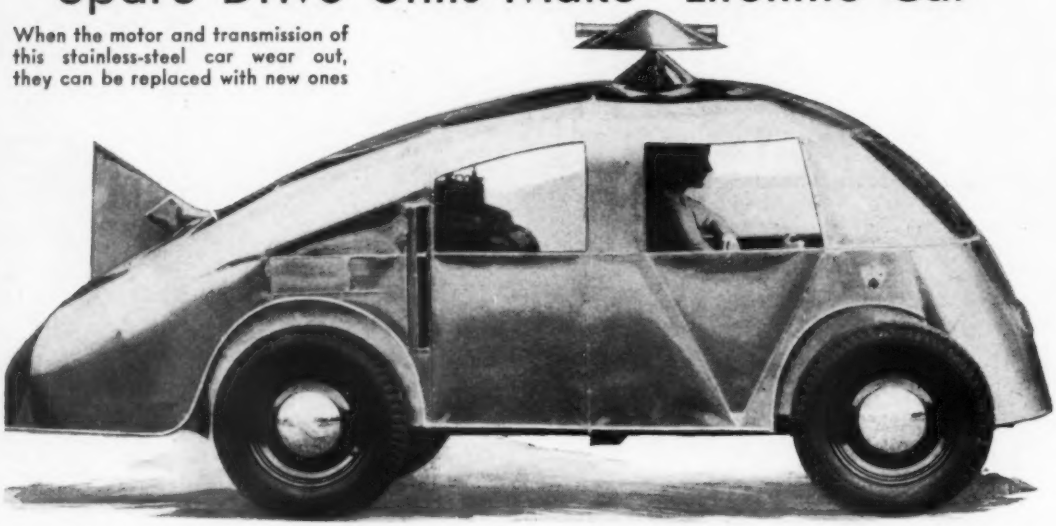
Varicolored bits of yarn are skillfully combined in the figure at left

At the right, Miss Bertilson is seen at work in her New York City home. A hobby taken up to pass the time during an illness has proved profitable

The tiny figure below in Swedish peasant costume brought thirty dollars

Spare Drive Units Make "Lifetime Car"

When the motor and transmission of this stainless-steel car wear out, they can be replaced with new ones



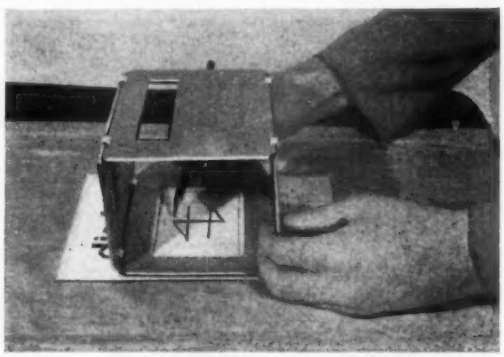
SHEATHED in stainless steel, a new streamline automobile has a compact driving unit that can be replaced in fifteen minutes. Feeling that the chassis and body will last indefinitely, the inventor claims that the replaceable-mechanism feature makes the vehicle a lifetime car. Another unusual feature is a lighting unit on the top that bathes both the car and the road in glareless illumination. Mounted in the rear of the car, the motor is cooled by air scooped in through slots at the sides, as seen in the photograph.

Comb Handle Curls Hair

COMB and curler are now combined in one unit for dressing the hair. Made of a durable plastic material, the comb handle has a slot in one end to hold strands of hair while the unit is turned to form a curl, as illustrated in the photograph above. Hairpins are then inserted to hold the curl in place, and the comb-curler is removed.

New Mirror Copying Game Baffles Smartest Players

SIMILAR to an old-time parlor trick, a novel game now on the market is said to baffle even the smartest players. The idea is to copy simple forms such as triangles, squares, and even straight lines, that appear on cards furnished with the outfit, while watching in a mirror the point of the pencil and the paper on which the design is being traced. This is done with a four-sided cabinet having a slot in the top and a mirror on its inside rear face.



Designs are copied with the pencil seen in a mirror

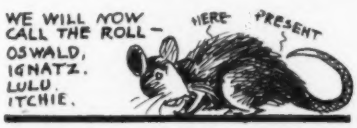
The Man with the Net

ELM TREES *suck thirty-four gallons of water from the ground for every pound they add to their weight.*

PAPER *made by wasps was used in a book published in Bavaria in 1765.*

DRY ICE *never melts. It turns directly from a solid to a gas.*

RATS *carry fifteen fleas on the average.*



SIXTEEN *packages of cigarettes would have to be burned to produce enough smoke to weigh one ounce.*

POTATOES *form the base of a new kind of synthetic plastic material produced in Holland.*

LEAVES *are greener on the upper surface where the sun strikes them.*

BEAVERS *are voiceless.*

OFFICE WORKERS *catch nine times as many colds as outdoor workers.*

SLEEP WALKERS *can now be protected by electric-eye robots which awaken relatives if the persons leave their beds.*

RUBBER *clothespins form the latest innovation for wash day.*

GILA MONSTERS *store excess energy in the form of fat in their tails.*

Special License Plates Tag Careless Drivers

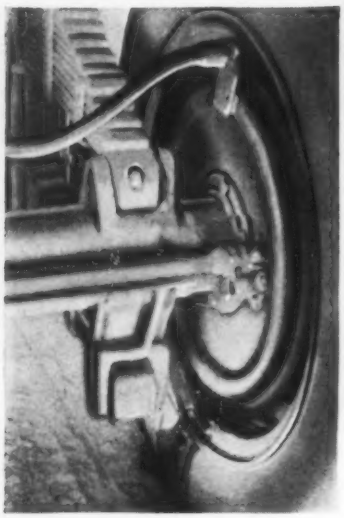
SPECIAL license plates for traffic violators are being considered as a safety measure by Cliff Davis, commissioner of public safety in Memphis, Tenn. If the measure is adopted, motorists who persistently break traffic laws will be required to turn in their regular license plates for special tags, similar to that shown in the photograph above, bearing a skull and the words "traffic-law violator."

Match-Book-Cover Album

AN ALBUM specially designed for hobbyists who specialize in collecting the covers of paper match books is now on the market. Bound in loose-leaf form so that additional pages may be added, the match-book album has pages equipped with sufficient corner tabs to hold eight covers on each page.

Collect match-book covers? This album holds them

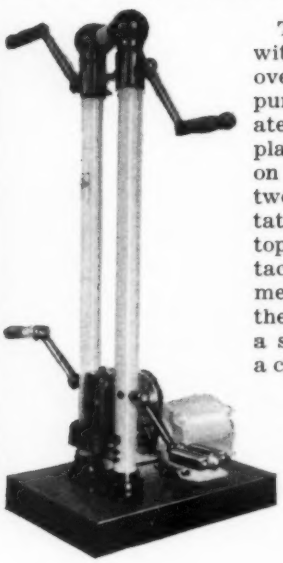
Water Cools Big Trailer's Brake Bands



Driver regulating the stream of water from the long tank above his hand. Left, inside of wheel, showing water channel around brake band

WATER-COOLED brakes are a novel feature incorporated in a giant truck trailer used to haul lumber out of the forests of Oregon. Tanks mounted at the rear of the trailer serve as water reservoirs, with metal piping leading down to the wheels. Tiny streams of water, the size of which can be adjusted by means of valves, flow down by gravity from the supply tanks to circulate over the brake bands, finally dripping off onto the road. A close-up of one of the rear wheels, showing how water plays over the brake band, is reproduced at the left. The water tank can be seen above the man's hand.

Electric Motor Runs Workless Exerciser

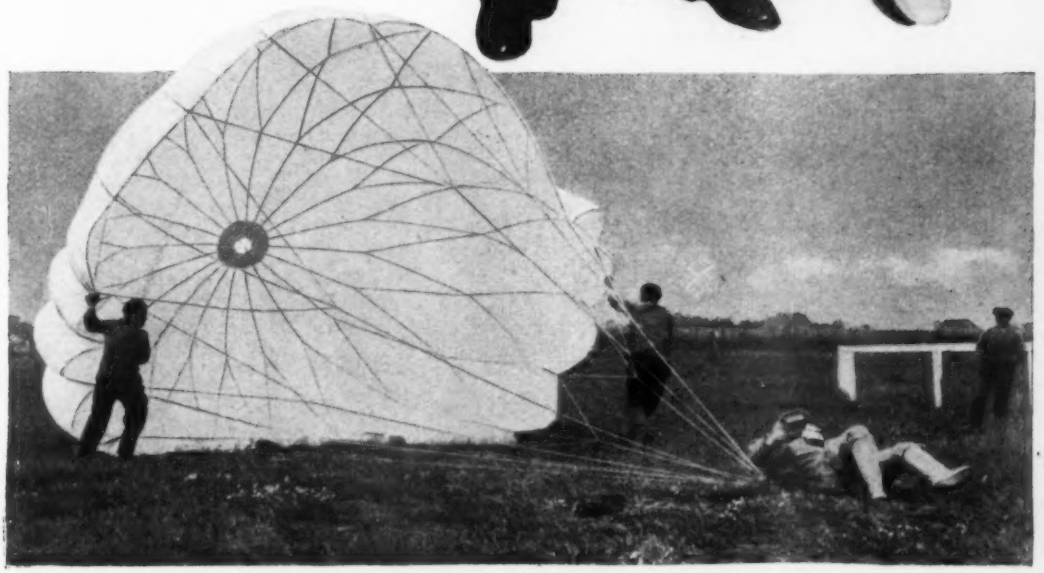


User sits in an ordinary chair. At the right is a close-up view of the exerciser

TO PROVIDE healthful exercise without any danger of strain, overexertion, or fatigue is the purpose of an electrically operated exercising machine recently placed on the market. Mounted on a square base, the unit has two vertical columns, with rotating handles fastened near the top and revolving pedals attached near the base. Unlike mechanical horses now available, the new exerciser does not have a saddle. The user merely pulls a chair up to the machine, places the feet on the pedals and the hands on the handles, and flips a switch that starts the unit's electric motor. This drives the mechanism to supply a rotating motion to the legs and arms.

Parachute Jumper Wears Aerial "Diving" Suit

PARACHUTE jumps from the stratosphere are made possible by a novel aerial "diving" suit recently given preliminary tests at Le Bourget air field at Paris. Made of special reënforced rubber, this French innovation is equipped with a lightweight metal helmet, and provides space for two oxygen cylinders to supply the vital gas to the parachutist as he plunges earthward through the rarefied air found at high altitudes. A lever on the helmet opens a porthole, so that the jumper can breathe the oxygen-charged air within the cabin of the plane as it climbs into the stratosphere. Just before leaping from the plane, the parachutist closes the helmet port, and turns on his oxygen supply, which he continues to use until he is close enough to the earth to open the helmet and breathe the outside air. The only precaution that must be taken, it is said, is to make sure that there is plenty of room for the jumper to get out of the plane, as the rubber suit balloons out when the air that is contained in it is expanded in the thin atmosphere of the upper air, making it difficult for the parachutist to get through the door of the plane's cabin.

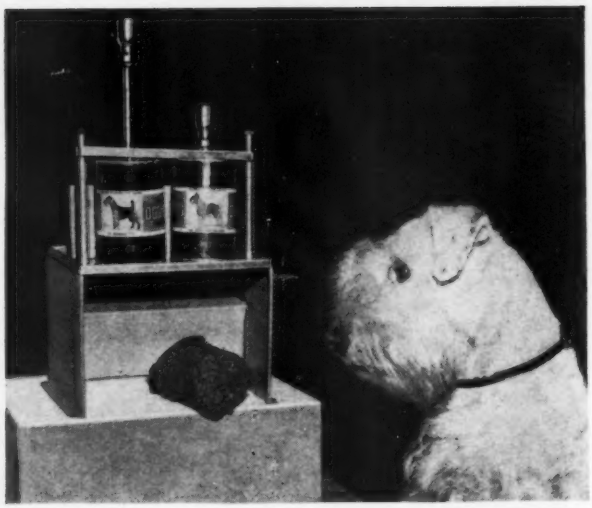


The end of a trial leap. Levers on the front of the suit, visible in the upper photo, control the oxygen supply

New Adhesive Thread Binds Electric Cords

ADHESIVE thread, designed for use in tying off the frayed ends of flexible electric cords and cables, and for other purposes, is now being manufactured in England. Three strands of cotton, laid side by side and dipped in a special adhesive compound, produce the material, which is sold in spools.

Made of cotton strands dipped in an adhesive compound, this thread has many uses



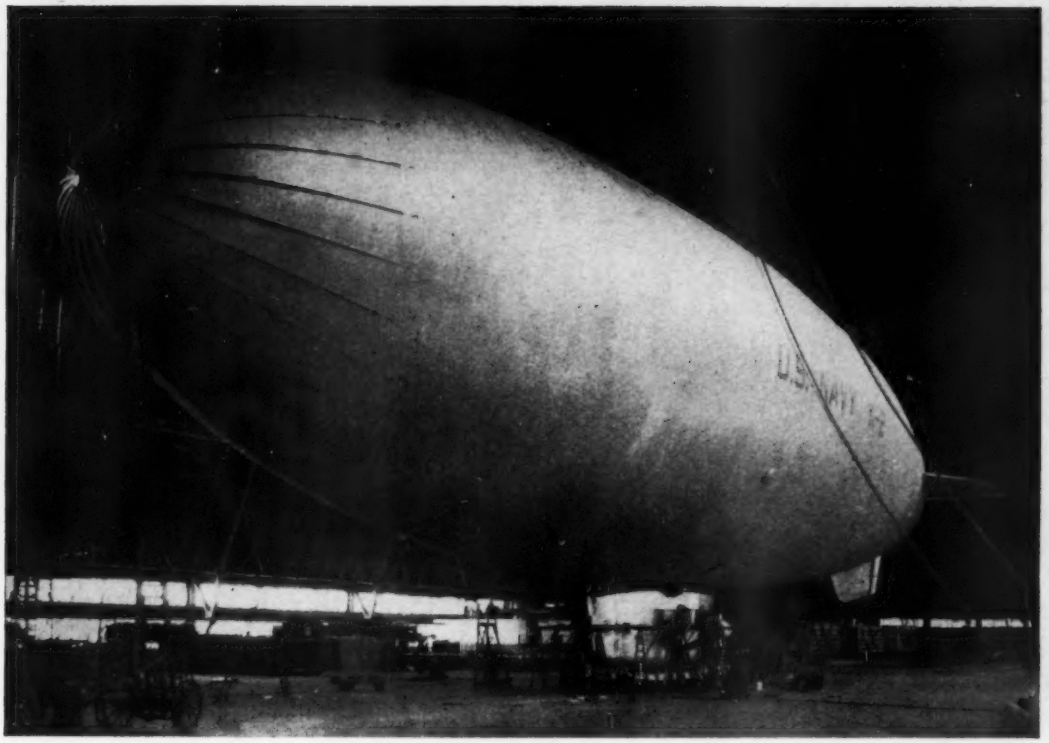
Automatic Canine Cafeteria

OPERATED by clockwork to feed pets their rations at any predetermined time, an automatic canine cafeteria has been invented by a California woman, Mrs. Alberta MacDonell, of San Francisco. The clock throws an electric switch which operates a piston to push the food from the can onto a tray below.

Basil Dhanens showing a visitor his hexagonal weather station. At right he examines some of his instruments

Private Weather Bureau Is Garageman's Hobby

OPERATING a one-man weather bureau, Basil Dhanens, a Vancouver, Wash., service-station proprietor, issues daily forecasts to farmers of his vicinity. Between his house and garage, four years ago, he erected a high steel pole which carries wind-measuring instruments. Their readings are transmitted electrically to an instrument board inside Dhanens's six-sided weather station. Another tower houses instruments for measuring rainfall and snowfall automatically to within a hundredth of an inch. Inside his hexagonal observatory, Dhanens has three barometers of different types. From the data he collects, he predicts coming storms, waves of heat and cold, and wet and dry spells.



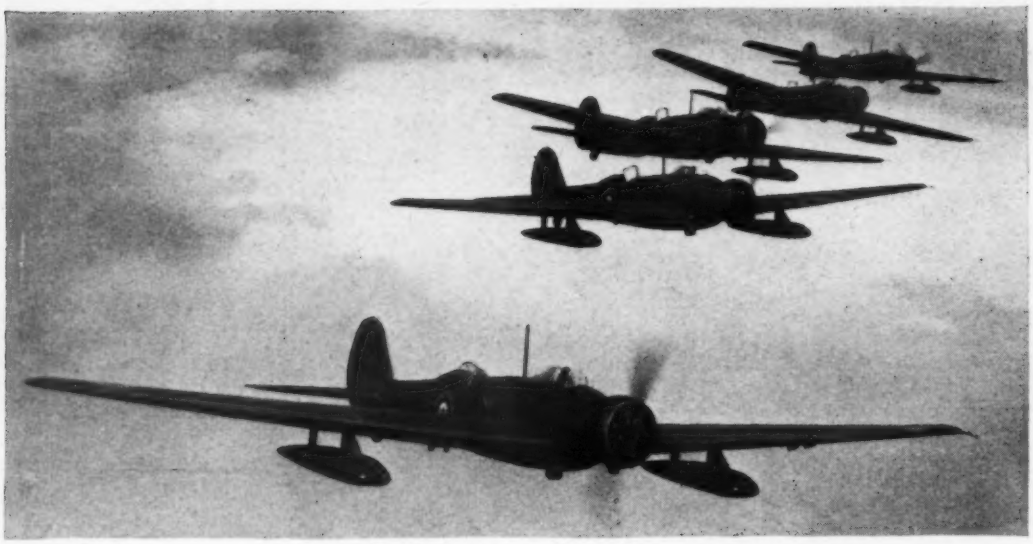
Giant Navy Blimp Carries Crew of Seven

NEARLY as long as the average city block, a new U.S. Navy blimp recently completed at Akron, Ohio., carries a crew of seven and has a 404,000-cubic-foot gas bag which will lift 25,000 pounds into the air. Known as the *K-2,* the giant nonrigid airship is driven by twin 550-horsepower air-cooled engines which spin three-bladed propellers ten and a half feet in diameter. The car of the dirigible houses the control mechanism and has accommodations for pilots, radioman, navigator, and mechanics.

Rapid-Fire Rifle Has Extra Barrel

ADAPTABLE for use at either long or short range, a new rapid-fire rifle invented by Melvin M. Johnson, a Boston, Mass., lawyer and a captain in the Marine Corps Reserve, has interchangeable barrels. In a recent test, the Johnson rifle fired 2,400 shots in ninety minutes, including reloading, from thirty to 100 bullets a minute coming from the gun. Whenever desired, the barrel of the rifle can be removed and another slipped into its place. One barrel is for long-distance shooting; the other for work at close range. Complete, the new firearm weighs less than ten pounds. Johnson's rifle is being studied by Government experts for possible adoption by the U.S. Army.

Changing barrels adapts the rifle for long or short-range use



Planes' Bomb Racks Resemble Pontoons

WHEN in flight, giant bombing planes recently completed for the British Royal Air Force look like seaplanes fitted with streamline wing pontoons. Actually, however, they are land planes. In the formation-flight photograph above, each ship has retracted its landing gear up into the fuselage. The "pontoons" are streamline racks for bombs, which are released by remote control from the cockpit of the huge craft.

Combs and Brushes at the Same Time

HAIR is combed and brushed at the same time with a new beauty aid now on the market. The unit comprises a narrow brush with a groove at one edge into which a comb may be inserted. In use, the comb passes through the hair just ahead of the brush bristles, as seen in the photograph above. If desired, either the comb or brush can be used separately.

Two-Way Radio for Ambulances

TWO-WAY radio sets are now being adopted by English hospitals as standard equipment for their ambulances. The transceivers will enable ambulance doctors to inform hospital attendants of the preparations to be made while a patient is being rushed to the hospital, so that no time will be lost on arrival.

Ambulance doctor communicating with hospital by two-way radio

"Freaks of Nature" Made to Order in Novel Tests

Normally solid brown, the salamander above bears a mottled band produced by an operation on the embryo

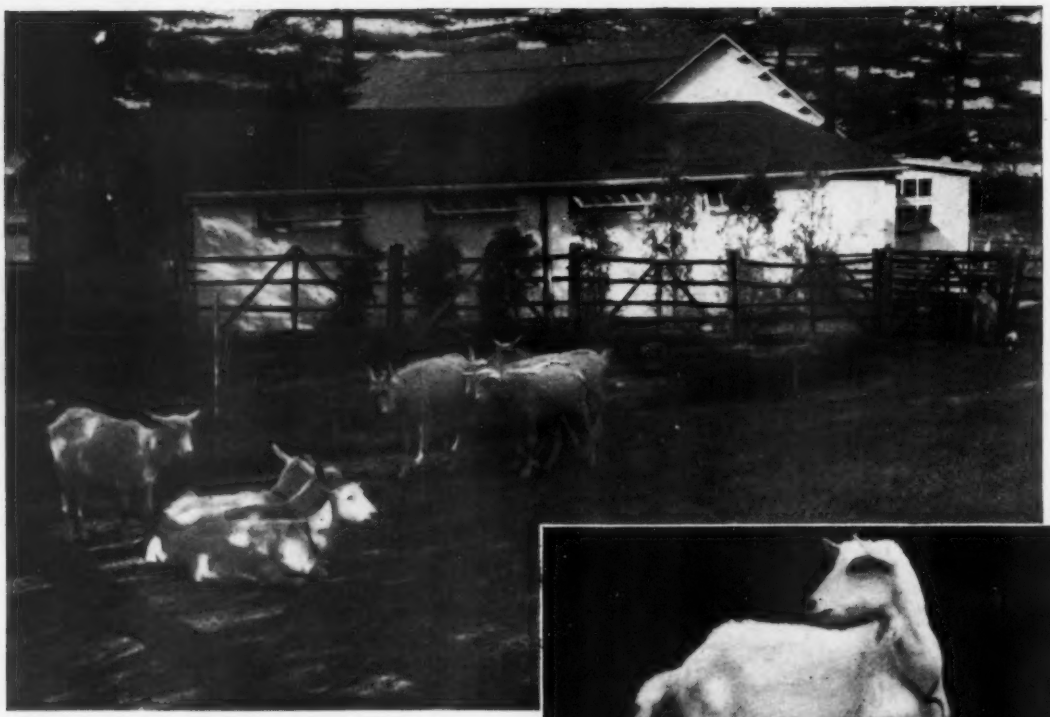
The skilled hands of Dr. Victor C. Twitty molding the destiny of a tiny salamander under the microscope. The quarter-inch embryo is seen at left, greatly magnified

BY TURNING a plain brown salamander into a spotted one, Dr. Victor C. Twitty of Stanford University in California recently added a new feat to his scientific achievements. In other delicate operations upon the lizardlike amphibians, he has produced Siamese twins, salamanders with extra legs, and specimens with eyes and heads in unaccustomed places. For such experiments, which some day may lead to the possibility of artificial control over human pigment and physical build, salamanders are used because of the extraordinary grafts that may be successfully performed upon them. To produce the freak mottled specimen, Dr. Twitty transplanted a patch of pigment cells from a normally spotted species to the quarter-inch-long embryo of the plain-colored variety.

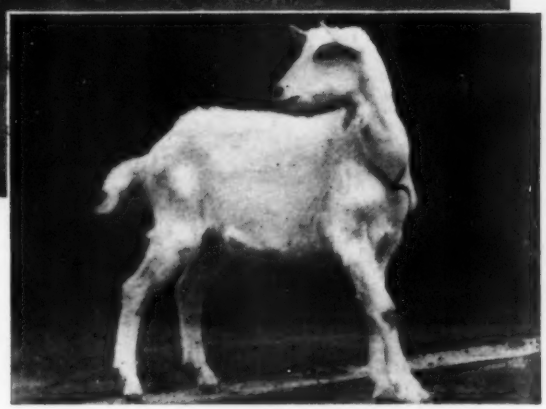
Spaniels Get Ear Muffs for Warmth and Comfort

IF COCKER SPANIELS get tired of lugging their long ears around, they have a friend in Ruth McCaleb of Evanston, Ill. She claims to be the first—and the official records of the Patent Office agree—to invent "ear pockets" for the oversize appendages. Hung over the dog's head, her fabric sling carries the ears so that they "may hang and swing naturally," she says, and keeps them warm besides. The illustration at the right shows Mrs. McCaleb trying it out on the dog.

Mrs. Ruth F. McCaleb tries out her invention on the dog



A scene at the Three Winds Dairy of Juan M. Ceballos, Wall Street broker, at Westbury, N.Y.



Just a kid. This is a specimen of the Saanen breed

Milking time. Goats are profitable pets to keep

Goat kids are as playful as puppies or kittens

Raising Is Profitable

AT SYRACUSE, N.Y., a few weeks ago, men and women from all over the United States gathered in solemn conclave to discuss the joys and problems of one of the fastest-growing and strangest business-hobbies in the country—the raising of blue-blooded milk goats. It was the third annual meeting of the American Goat Society, the youngest of three American

Frank R. Coutant's pets welcome him at the pasture gate

These comical creatures are kids of the Nubian breed

Three Winds Dairy's bar serves nutritious goat milk

Milk Goats New Hobby

By KENNETH M. SWEZEY

organizations devoted to goat culture and the registration of goat pedigrees.

Started thirty-odd years ago by a group of goat fanciers who imported a few pure-bred animals from Europe, pedigreed-goat raising now enrolls thousands of fans—including movie stars, farmers, business executives, and housewives. Known officially by the fancy name of capriculture, the hobby already supports three magazines devoted to goat news, three registration societies, and at least a dozen breeders' organizations.

Strange as it may seem to most Americans, who know only the smelly, comical-looking, tin-can-gnawing type of American goat, well-bred European and African milk goats are beautiful, intelligent, and affectionate creatures that remind one strongly of deer. They are scrupulously clean in their eating habits, and make excellent pets. Pure-blooded mature females, or does, bring from seventy-five dollars to $150 each, while a prize winner has brought as much as $2,000. Pedigreed bucks bring even higher prices. Bucks do smell a bit rank, even the well-bred ones, and for that reason must be kept by themselves in their own private barns or

stables, but does are entirely odorless.

Dogs and cats may make good pets, also, the goat raisers agree, but what other pet than the goat, they argue, can earn its keep? The chief reason for raising goats is really for the milk, which is delicious, rich, healthful, and economically produced. A single goat should produce upward of two quarts of milk a day—enough to supply an average family—for nine or ten months of the year. If you buy all its food, its cost of keep is less than ten cents a day. Seven or eight goats may be fed for the cost of feeding one cow. At retail, goat milk sells for from fifteen to sixty cents a quart. Marketing the milk from a herd of from twenty to a hundred goats, one can make a comfortable income.

When goat milk is not used entirely by the owner, it is often sold to hospitals, to invalids, and to families with young children. Although it looks and tastes almost like cow milk, it has special properties which render it particularly good for body building and for correcting certain nutritional difficulties. For one thing, its reaction in the stomach is alkaline, while that of cow milk is acid. It forms a much softer curd, and its fat globules are smaller; therefore it digests more easily. Goat

"CERTIFIED" MILK

Here a worker is capping bottles of goat milk. At scientific dairies, elaborate precautions are taken to insure the animals' health and cleanliness

A Toggenburg, one of the most popular breeds of pedigreed goats, resembles the white-tailed deer

At the right is an Anglo-Nubian, produced by crossing goats of a strain that originated in Abyssinia with an English breed

And this is a Saanen. Combining beauty with good milking qualities, this breed is second in popularity in America to the Toggenburg. Note the chin wattle

milk is considerably richer in iron, and in vitamins B and C, than milk from even the best Jersey cow. As goats are almost entirely immune to tuberculosis, goat milk is seldom Pasteurized, but is generally sold as "certified," or highest grade of raw milk.

Besides the income from milk, goat raisers also derive revenue from selling breeding stock, goat cheese, goat candy, goat skins, goat manure, and goat meat. Buck kids, which are not to be raised for breeding, are killed young for meat.

The four most popular breeds of milk goats among American raisers are known as Toggenburg, Saanen, Nubian, and Alpine. The first two are products of hundreds of years of careful breeding in Switzerland. It is claimed that they have a pedigree dating back to the time of Charlemagne, and that the Toggenburg type was the result of crossing native does with wild chamois of the Swiss Alps.

Except that it is smaller and a slightly darker brown, the Toggenburg resembles the white-tailed deer of America. Saanens are similar in build, but pure white. Nubians are large, exotic-looking animals with flop ears and Roman noses, that derive originally from Nubia *(Continued on page 244)*

A. F. A. Konig, of Newtown, Conn., with a Toggenburg doe

Mealtime in Konig's model dairy barn. After browsing all day, the goats are fed on grain and alfalfa

Piped Light Aids Surgeons and Dentists

PIPED LIGHT, providing surgeons and dentists with powerful, sterile beams devoid of heat, glare, or the danger of electrical shock, is made possible by instruments molded from a transparent plastic which carries light around curves and bends (P.S.M., March '37, p. 43). The molded, hand-held rodlike instruments have electric bulbs at their bases, powered either through extension cords from transformers that cut down 110-volt current to six volts, or by flash-light cells in a special base. Among the new plastic instruments are a tongue depressor that throws a concentrated beam on the throat of a patient, a retractor which serves the double purpose of holding back the cheek and lighting the mouth, and a long curved rod which casts a brilliant beam on the teeth.

Intended for use by dentists, this stand-type lamp throws light through a curved rod of transparent plastic to cast a brilliant, shadowless beam directly onto the teeth of a patient

By combining a light with a cheek retractor, the instrument pictured above serves the double purpose of holding back the cheek and supplying illumination for the work. Another aid is the tongue depressor at right, powered by flash-light cells inside the handle

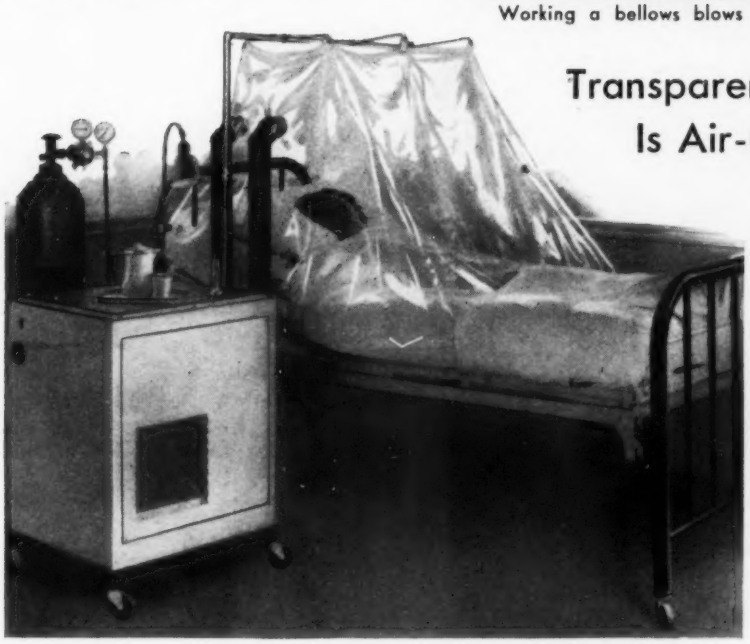
Movie Make-Up Tested On Human Guinea Pig

ACTING as a human guinea pig, Mary Bovard, California film actress, hires out her face as a testing ground for new make-up materials before they are approved for use by screen stars. Selected by a cosmetic expert for the delicate texture of her skin, Miss Bovard submits to constant experiments for determining the blend of make-up to give the best appearance on the screen.

Old Horn Calls Egg Dealer

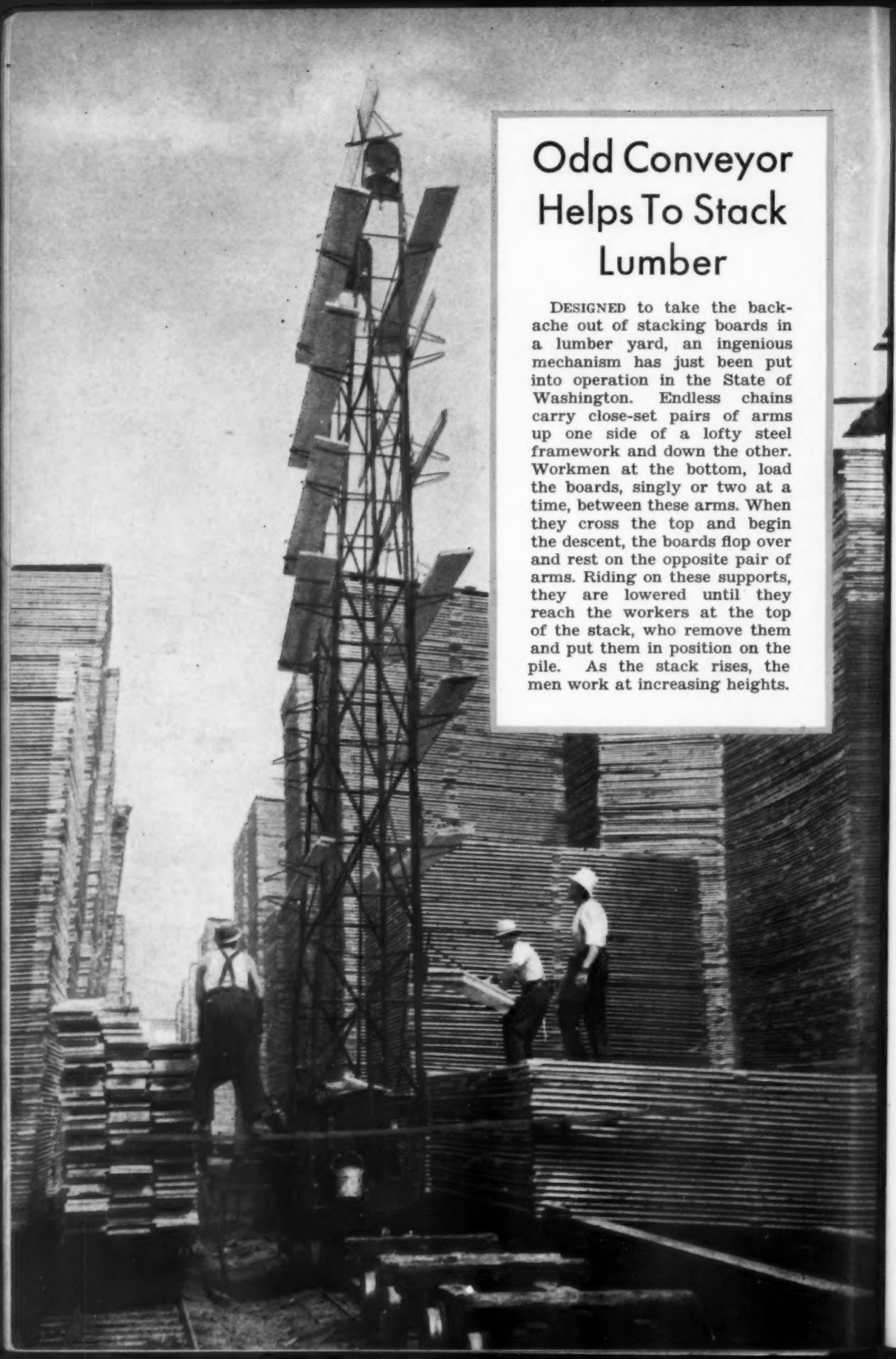
"BLOW FOR EGGS" reads the odd sign over an old horn fitted with bellows and mounted on a roadside tree on an English poultry farm. A toot on the horn denotes the presence of a customer when the owner is working at a remote point on the farm.

Working a bellows blows the horn to get service



Transparent Oxygen Tent Is Air-Conditioned

AN AUTOMATIC air conditioner takes the place of the conventional icing unit in a new oxygen tent recently introduced. Plugged into a wall outlet, the electrically operated apparatus furnishes a continuous supply of cooled, conditioned air to a patient within a tent canopy made of a transparent, rubber sheeting. The canopy is discarded after use, to prevent any danger of spreading infection.



Odd Conveyor Helps To Stack Lumber

DESIGNED to take the backache out of stacking boards in a lumber yard, an ingenious mechanism has just been put into operation in the State of Washington. Endless chains carry close-set pairs of arms up one side of a lofty steel framework and down the other. Workmen at the bottom, load the boards, singly or two at a time, between these arms. When they cross the top and begin the descent, the boards flop over and rest on the opposite pair of arms. Riding on these supports, they are lowered until they reach the workers at the top of the stack, who remove them and put them in position on the pile. As the stack rises, the men work at increasing heights.

"Guinea-Pig" Plants Get No Sun or Soil

To study its effect, light from the unit above is directed on plants growing in water and chemicals in the revolving jars at left

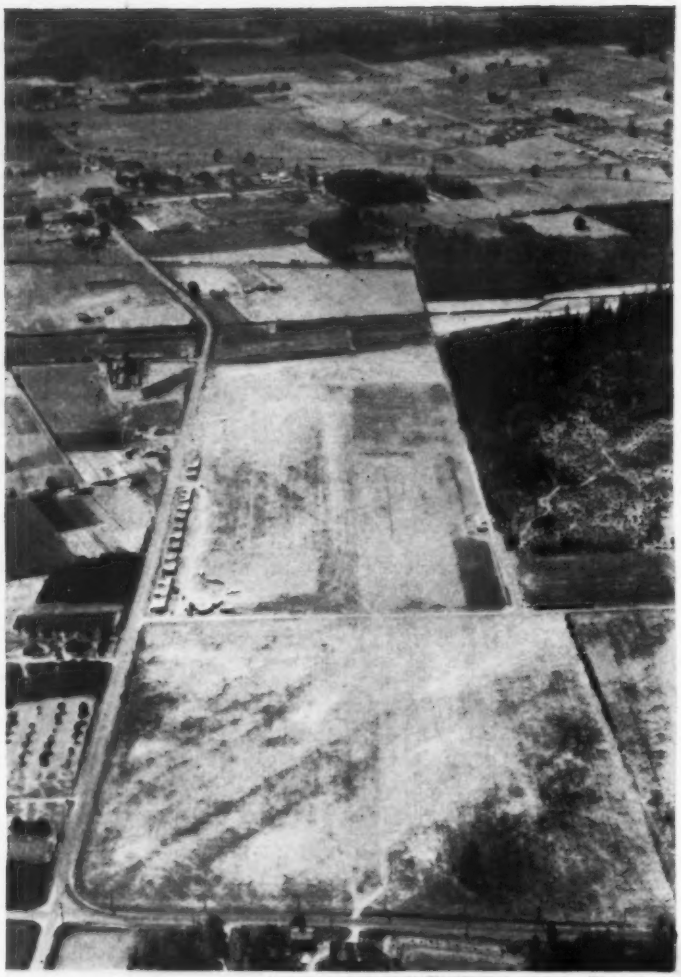
GROWN without either sunlight or soil, "incubator tomatoes" at the Smithsonian Institution, in Washington, D.C., are helping scientists to study the mysterious effects of different kinds of light on plant growth. By feeding the tomato plants with chemicals dissolved in water, rather than by letting them grow normally in soil, Dr. Earl S. Johnson and others of the Institution staff have reduced the number of variable factors in the tests to a minimum. The tomato plants form "botanical guinea pigs" on which the experiments are made. Placed in pots that are revolved at a constant speed to give all sides of the plants the same amount of light, they are subjected to artificial illumination. Some of the plants are placed under light that is predominantly blue; others under illumination predominantly yellow; still others under light predominantly red. As the plants grow, the effects of the different kinds of illumination are noted by the research workers.

Dual Wipers Clear Car's Rear Windows

"SEESAW" wipers that rock on a central pivot and clear rain and snow from the rear windows of a closed automobile, form one of the latest safety innovations for motorists. The wipers can be set in motion by means of a button on the dashboard. By clearing the rear windows, they enable the motorist to see behind his machine through the rear-view mirror when driving under adverse weather conditions.

The rear-window wipers are controlled by a button on the dashboard

Homemade Airport

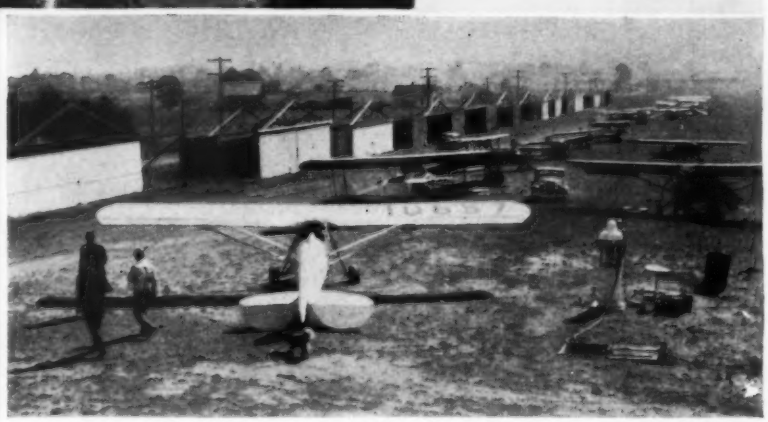


ELEVEN homemade airplanes, embodying eleven different combinations of construction, roared northward from the "lower forty" of Charlie Bernard's farm at Beaverton, Ore., and cut across lots ten miles to Hillsboro. There the amateur pilots—mechanics, truck drivers, loggers—zoomed and dived, putting on an hour's show to help local air enthusiasts establish an airport. Then they flew in formation back to their home lot and sideslipped in the gathering gloom to an assortment of bumpy landings.

Charlie Bernard is a dirt farmer, not an aviator. Nine years ago, observing that private flyers needed a roost of their own, he got an idea. Give them an airport where they could build and fly unhampered in planes of their own choosing.

How that idea caught on! Around his "lower forty," better known in Oregon as the Beaverton airport, twenty-nine hangars today house twenty-nine ships, from twin-cylinder babies capable of carrying only one man

Looking down on the Beaverton, Ore., airport, haven for amateurs who construct their own airplanes



Homemade craft in front of the row of hangars. The nearest ship has flown more than 3,000 hours

for Homemade Planes

How a Forty-Acre Field on a Small Oregon Farm Has Been Made a Haven for Amateur Aviators

By
ANDREW R. BOONE

• •

Charlie Bernard shows how hangar doors at the farm airport move on old automobile wheels that roll along small logs

aloft to multicylinder monoplanes which match in speed and power well-known production jobs from the big factories. Homemade ships, built by boys and men engaged in full-time jobs, to satisfy their craving to fly. Planes and engines costing as little as $400, assembled and ready to leap swiftly into the sky.

Drive out eight miles from Portland on a sunny afternoon, and you may find 200 automobiles parked around the field, their occupants watching a score or more of these farm pilots tuning up engines, rounding out the belly of a square fuselage, installing sliding cockpit covers, or trying out some new idea in construction.

Just the other day, two Portland mechanics trundled a new low-wing airplane onto the field. Fred Shepard and Tom Krum are their names. For six months the two boys had been building that job, and when I visited Beaverton they were putting the finishing touches on their wire-braced, streamline landing gear.

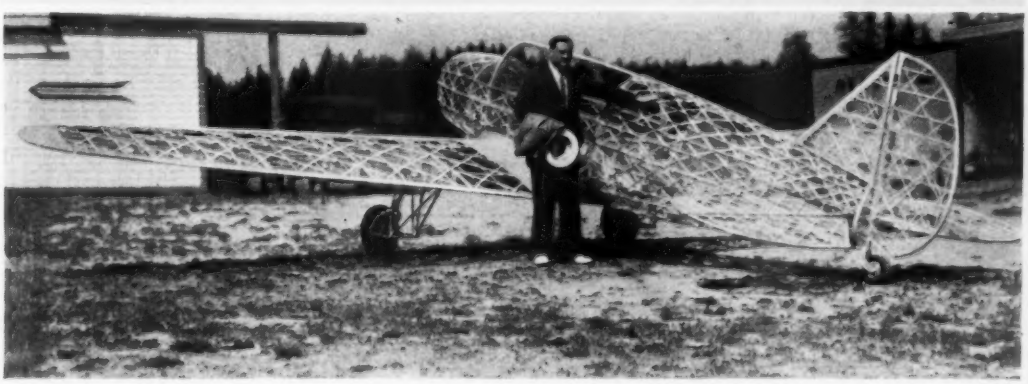
"What'll she do?" I inquired.

"Ought to beat 105, top," Shepard told me.

"Sort of expensive, just for an occasional flight, isn't it?"

"That depends," explained Tom Krum. "Figuring the sixty-five-horse-power engine and all materials, she stands us $450."

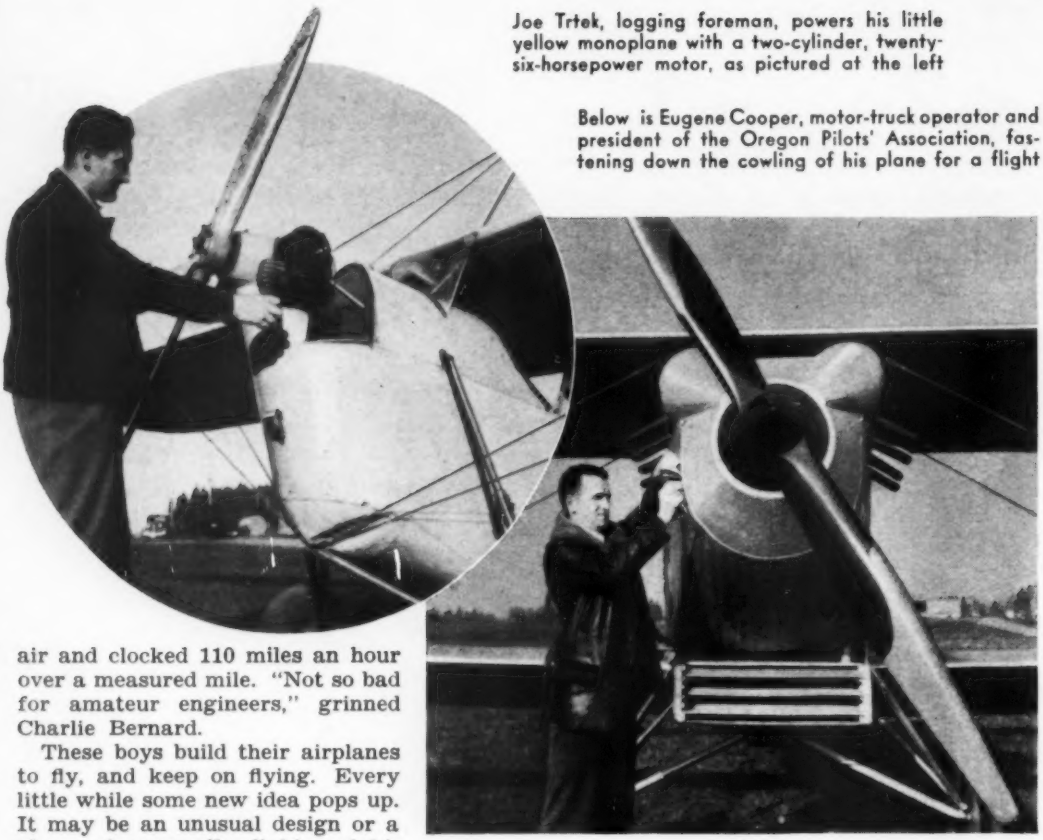
Later that afternoon, the boys took to the



Allan D. Greenwood, state inspector, poses beside a basket-weave monoplane built at the Beaverton field

Joe Trtek, logging foreman, powers his little yellow monoplane with a two-cylinder, twenty-six-horsepower motor, as pictured at the left

Below is Eugene Cooper, motor-truck operator and president of the Oregon Pilots' Association, fastening down the cowling of his plane for a flight

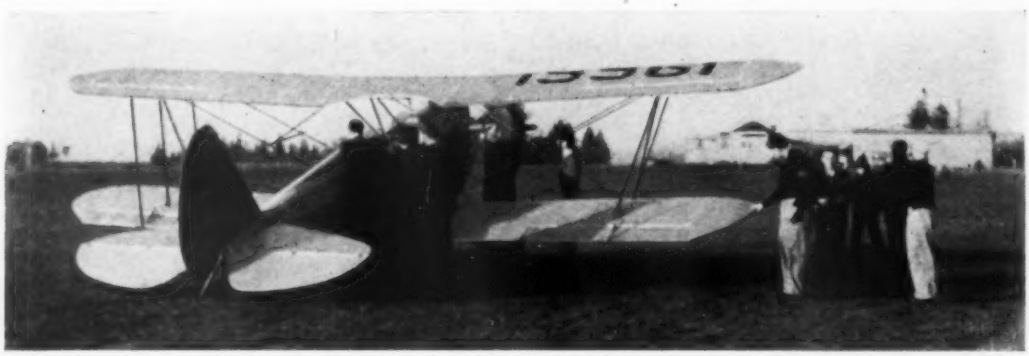


air and clocked 110 miles an hour over a measured mile. "Not so bad for amateur engineers," grinned Charlie Bernard.

These boys build their airplanes to fly, and keep on flying. Every little while some new idea pops up. It may be an unusual design or a plane of unusually light weight. George Yates, who helps engineer some of the jobs and test-flies most of them, started it with his "geodetic" monoplane. Uncovered, it resembles a basket. Even the wing contains no spar, strength being derived from the webbing itself. For nearly a decade Yates has been flying that ship, now having logged 3,000 hours and worn out three engines with her. Not one crack-up mars her record.

Allan Greenwood, Oregon's official aircraft inspector, licensed that plane. He approved the principle and later designed a bimotor low-wing monoplane of basket construction. This ship soon will hit the skyways. Except for a single wing spar to support the weight of the landing gear and the engines, the crisscross strips of metal will be the only strength members.

That's one side of the picture. On the other you see Joe Trtek's little yellow monoplane. When his job as foreman in a logging camp permits, Joe tinkers with his tiny twin-cylinder monoplane. Twenty-six horsepower is all he boasts. Or Walter Ruppert's forty-



Visitors swarm over the field on holidays. Here a curious crowd surrounds a reconstructed commercial plane

Fred Shepard and Tom Krum beside the plane they built at a cost of $450. It has made 110 miles an hour

two-horsepower monoplane, which his fellow flyers described as the "sweetest-flying job" on the field. Equipped with wheel brakes and a tail wheel (most of 'em land on skids), his high-wing flyer climbs 1,250 feet a minute and cruises at ninety-five miles an hour. Or Buford Johnson's spinproof—well, nearly spinproof—ship. Johnson took three years to that job, which I learned was an average construction time on these back-lot ships, but he turned out a high-wing monoplane that proved the envy of all the boys in the region.

These flyers never think of buying a ready-made airplane. Most of them start with a set of plans, then throw away the plans and finish the job to suit themselves. Only one of the bunch carries a Federal license, while all have qualified for Oregon papers. "State's examination is tougher, too," Yates assured me.

They started from scratch in more ways than one. When Bernard announced that they could use part of his 400-acre hay-and-grain farm, pilots from all over the state pitched in to level the field. "You'd never think it to look down this runway," Bernard said as we observed a youngster wabbling uncertainly on a take-off, "but I wore out a tractor knocking down the high spots." Hangar by hangar, the project grew. All you need do is pay from five to seven dollars a month for hangar space. Only other qualification is go to the end of the line. Fifteen part-time flyers already are awaiting their turns for hangar space, and opportunity to build planes of their own. The fact that they may take four years to do the job seems to discourage few.

At intervals, the builder-pilots assemble at the field and take off on tours, sometimes for sport, again to help other flyers sell their communities on airport improvements. Each year they assemble at Salem, the state capital, for a big air show. Not always are these pleasure trips, however. Not long ago, action was threatened which would deny these fellows the right to fly their planes. Almost overnight they laid their plans to visit a legislative committee. Nearly 300 swooped down on Salem, by plane, bus, and car.

"Boys," the committee chairman finally announced, "if you've got nerve enough to build and fly those crates, we won't stop you."

Few rules hinder the boys in their hobby. "Keep it safe," preaches Eugene Cooper of Multnomah County, truck-driver president of the Oregon Pilots' Association. "The boys present no hazard to interstate flying," Bernard told me, "and I guess the State of Oregon can regulate us adequately." Then he stepped off space for ten more hangars.

"Sweetest-flying job on the field" is Walter Ruppert's open monoplane

Rotary File Is Office Aid

A turn of the wheel brings any of the portable file's 25,000 cards instantly to view

FILE clerks and other office workers can consult any one of 25,000 record cards quickly and conveniently when filed in a portable, revolving record cabinet now available. The unit, mounted on casters so that it may be moved up to a desk or from one room to another, houses a central wheel divided into seven segments containing record cards. Any card may be found merely by turning the wheel.

Machine Scrubs Stonework

STONEWORK may be easily scrubbed clean with an electrically powered brushing machine devised by a New York City apartment-house superintendent. Resembling a floor waxer without the conventional long handle, the motorized brush has a special arrangement of ball bearings to allow it to be used efficiently while held in a vertical as well as a horizontal position.

How the machine is held to scrub stonework of a building

Game for Children Tests Lung Power

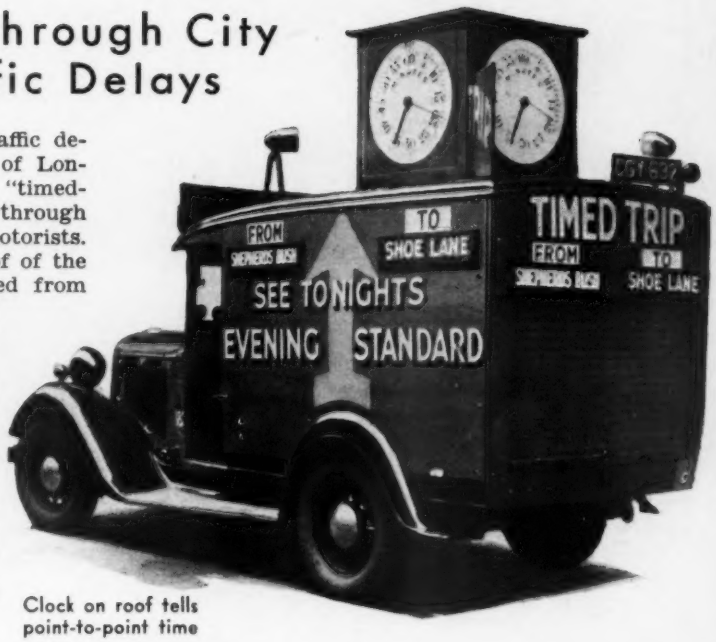
BLOWING three featherweight balls into cups fastened to the inside of a transparent cylinder is the object of a novel toy game now on the market. As shown in the photograph above, the player blows into the hollow stem of the toy, causing a blast of air to stream upward from the base to lift the balls into the cups.

Generator Regulator

ELIMINATING hand control, a new, compact voltage regulator for industrial electric generators is now available. The device, which consists of a number of graduated resistances selected automatically, keeps generators delivering power at constant voltages regardless of loads.

Timed Trips Through City Locate Traffic Delays

TO TRACE the causes of traffic delays, an evening newspaper of London, England, is sending a "timed-trip van" on regular journeys through the city's trouble spots for motorists. A four-sided clock on the roof of the truck shows the time elapsed from the beginning of the trip, a large black hand registering the minutes and a red one the seconds, while placards on all sides of the machine announce the starting point and destination. Final results appear in the next edition of the paper. The novel survey is expected to aid in untangling highway snarls that inconvenience travelers and cost industry vast sums of money daily.

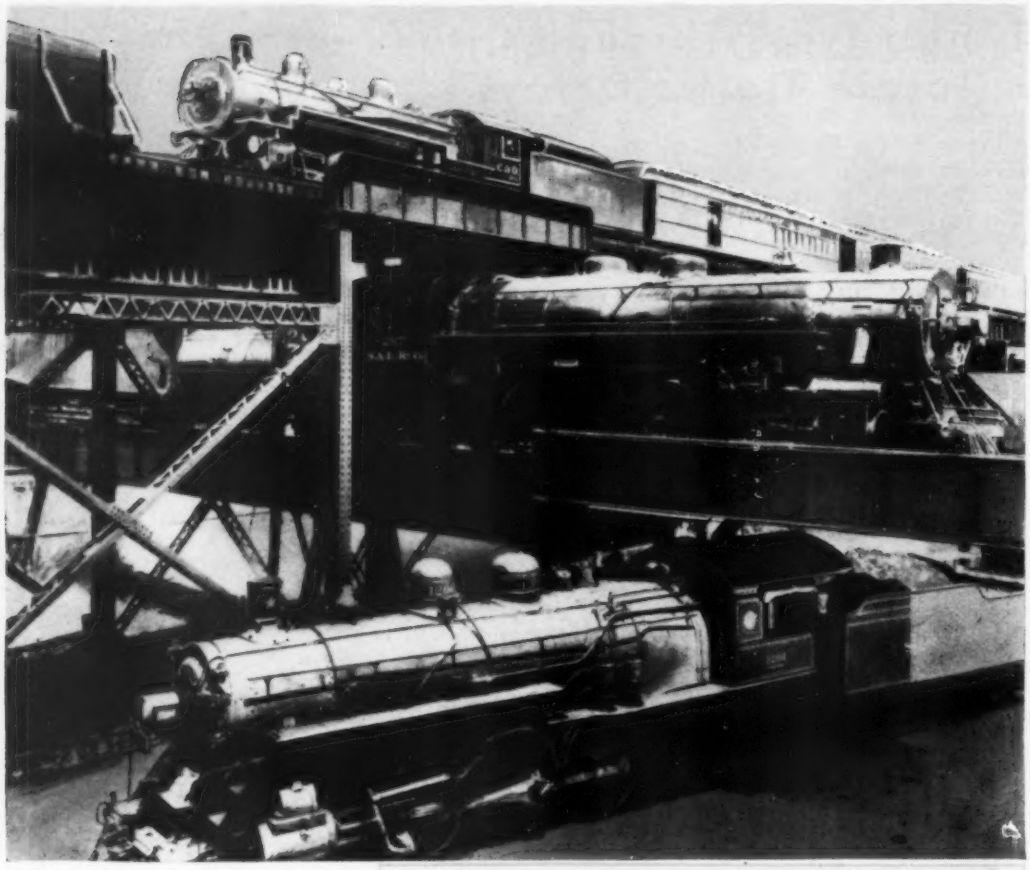


Clock on roof tells point-to-point time

Bikes Are Tested in Novel Safety Drive

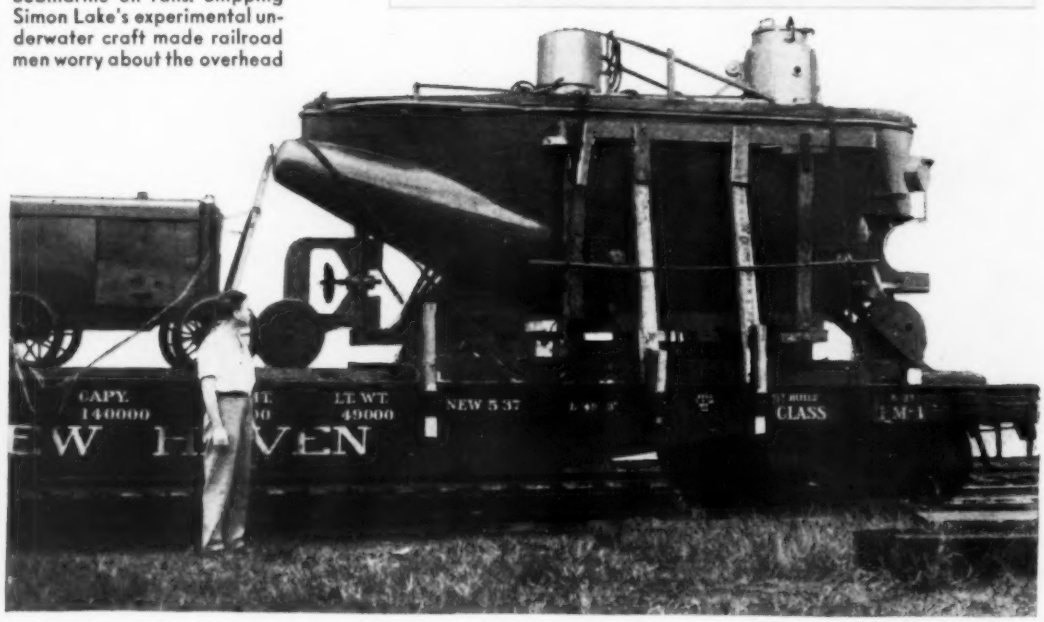
WHAT is called the first bicycle-safety-testing lane has been inaugurated at a Chicago high school, where 1,100 owners recently submitted their machines for inspection. Upon approval of brakes, lights, reflector, horn or bell, tires, spokes, chain, and pedals, each owner received a metal tag certifying the bike to be in safe condition to ride. Sponsored by the local board of education, the tests, shown in the photograph below as they were being conducted, aided a campaign of the National Safety Council.

This inspection line, patterned after those used for cars, passes on the mechanical fitness of bicycles



A railroad clearance engineer's nightmare is this triple crossing at Richmond, Va., where three main lines converge

Submarine on rails. Shipping Simon Lake's experimental underwater craft made railroad men worry about the overhead



Low Bridge!

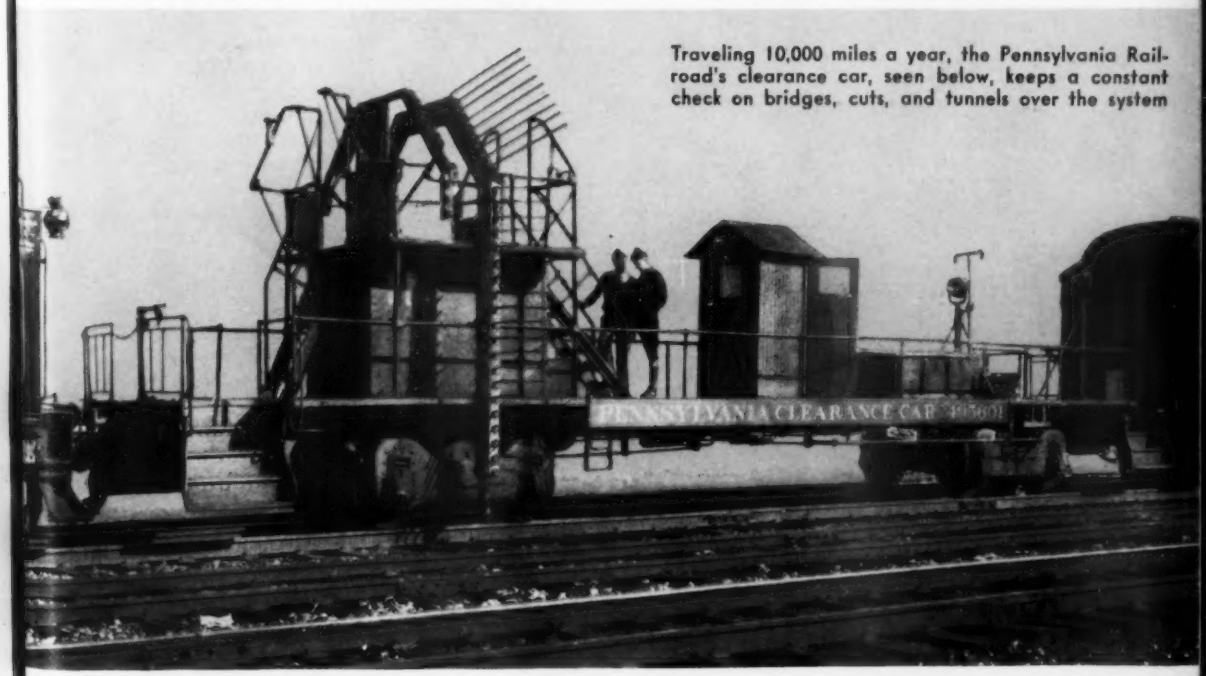
. . . HOW RAILROAD MEN PUT CAMELS THROUGH NEEDLES' EYES

A CIRCUS giraffe, thrusting his beanpole neck through the top of his special crate car, recently held up a train load of animals in front of an overhead bridge fifty miles from their next show town. The giraffe was three inches too tall to pass under the bridge; forward motion of the train meant that the giraffe would get his valuable neck broken. The conductor, unable to cope with this bizarre traffic complication, phoned the headquarters expert in charge of freight clearances. It was a new problem, but the clearance expert was equal to it. "Drop a carrot into the giraffe's crate," he advised. The carrot was dropped, the giraffe ducked down to get it, the engineer jerked the throttle, the train went under the bridge, and all the animals got home that night.

This little byplay with a giraffe is only one of the dodges by which clearance experts solve the "low bridge" hazard that confronts railroads. Every overhead railroad bridge (the New York Central alone has over 2,000) menaces freight revenue by limiting the height of the objects that can pass under it, thus creating plaguy clearance problems for traffic specialists who are masters of the "near thing and the narrow shave." This clearance expert is a combination of lightning calculator, trouble shooter, and handcuff-escape artist. With slide rule, charts, and raw ingenuity he gets his shipments in and out of daily squeezes that would baffle a Houdini. His bible is a huge volume which tabulates every bridge and side clearance in the United States, Canada, Mexico, and Cuba. More than a million obstructions are listed. This clearance information is gathered by the railroads themselves, and is kept accurate by constant rechecking.

The Pennsylvania, for example, operates a "clearance car," running it continually

By DAVID O. WOODBURY



Traveling 10,000 miles a year, the Pennsylvania Railroad's clearance car, seen below, keeps a constant check on bridges, cuts, and tunnels over the system

over every foot of its tracks and filing the data obtained for each obstruction. A frame erected on the car carries a bristling array of wooden "feelers" marked off in feet and inches from a point midway between the rails. As the car pushes past a tunnel wall or bridge girder, these rods are thrust aside and the official measurer can tell at a glance just how close each obstruction is. This handy device is always on the move, travels some 10,000 miles a year, and does the work in a fraction of the time that would be required by hand. With the accurate measurements it provides, the Pennsylvania handles 2,500 close-clearance shipments a month, with practically never an insuperable jam.

Two years ago, a mining company asked the Canadian Pacific to transport the 100-foot river steamer *Radium King* from Montreal to the banks of the Mackenzie River, on the other side of the continent. Innumerable obstructions along the 3,000 miles of single track through northern Canada would prevent any such bulky object from passing. But an ingenious clearance expert came to the rescue. "Just cut *Radium King* up in sections, ship her on flat cars, and weld her together at the end of the trip," he proposed. This was done; the vessel is now on the Mackenzie River, giving as fine service as if she had been built on the spot.

When the fate of some revenue-producing giant hangs in the balance, the clearance expert tries a thousand shifts. He has switch stands and water tanks taken down, station canopies lifted. Sometimes he digs under a track, sinking it as much as a foot or two to get the proper clearance. Again, he has tracks actually pulled up and moved. If all this is futile, the clearance man becomes an expert geographer and goes to work with maps and diagrams to see how he can avoid immovable obstructions. Routing is often necessary over a combination of lines, frequently back and forth several times between the same two. A railroad would rather share a big freighting job with a rival than refuse it altogether. The Boston and Maine, for instance, has a main-line connection with the West through the five-mile bottle neck of the Hoosac Tunnel, in western Massachusetts. Shipments are often accepted which cannot pass through the tunnel, and then are often surrendered to the little Rutland Railroad for a short by-pass to the north. The Rutland gets a good share of its business this way.

The most difficult shipping problem ever offered to an American railroad was the disk of glass for the Mount Palomar telescope, the largest in the world. The original specifications for the mirror called for a 300-inch diameter, but traffic experts warned the manufacturers that such a tremendous piece of glass would stand twenty-five feet high—nearly eight feet higher than the average bridge. Regretfully, the scientists had to drop their figures to 200 inches. Thus the height of a railroad bridge can, and in this case did, limit the achievements of modern astronomy.

Before the fragile glass could be shipped from Corning, N.Y., to Pasadena, Calif., approximately 1,000 bridges were carefully "cleared" in advance by the experts in charge. The narrowest squeeze anticipated was at a low bridge in Kansas City, Mo., but even here, the blueprints showed that the disk,

Forty-two cars bearing gate sections for Boulder Dam. A shipment like this requires close calculation for routing

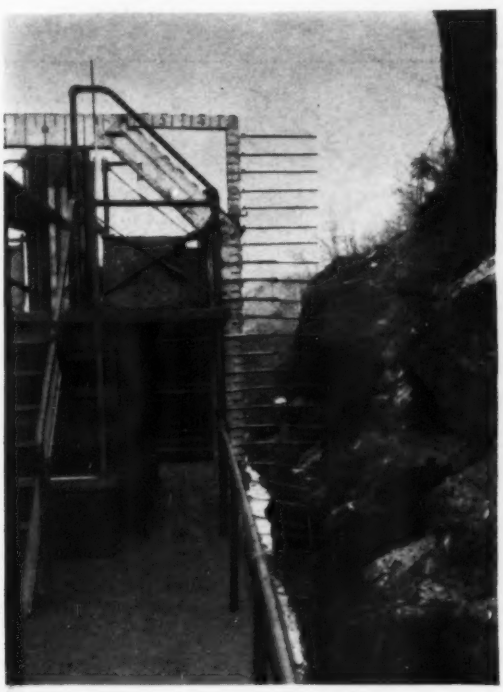
standing seventeen feet and seven inches above the rails, would have a margin of safety about the thickness of a pocket Bible. When the train arrived, however, not even a sheet of paper would slip between the top of the crate and the bridge girders. Frost had heaved the tracks just enough to destroy the tiny margin of clearance! Only a tortuous detour over a rival railroad solved that one.

Seventeen feet of height and eleven of width are the usual clearance allowed on eastern roads; modern trackage in the West usually gives a foot or two more. Naturally, the railroads and the manufacturers try to work together; the maker must build his machines so they will clear known obstructions. If he can't—or won't—then it is up to the expert to squeeze the giant through by dismantling his railroad, or by trick methods of routing. When both these fail, the expert must say "No," and the shipment doesn't go. Whereupon everybody loses money and business.

America lives by huge machines—vast dynamos, turbines, and steam shovels that grow larger all the time. But railroad bridges remain a fixed quantity. To gain the few necessary feet in the dimensions of their machines, large companies like General Electric and Westinghouse now build their own special drop-bottom flat cars. These cars are so constructed that a large object can be slung between the wheels of the car, barely clearing the rail tops and thereby reducing head clearance by several feet.

The gigantic pipes that are now a part of Boulder Dam *had* to be thirty feet in diameter. No railroad in the United States could deliver them, so a pipe-casting factory had to be erected at the dam site. A New Jersey manufacturer recently made a large oil tank destined for a refinery in Illinois. No railroad could touch it, although every line to the West was canvassed for clearances. Finally the maker, in disgust, had the tank moved to Hoboken on a motor trailer, dumped into the Hudson River, and towed by tug some 1,500 miles through the New York State Barge Canal and the Great Lakes to the customer. The journey took ten times as long as it would have if the tank had been a few inches smaller and could have gone by rail.

A new type of difficulty has arisen in handling freight trains on electrified railroads. Here, a nine-inch-wide gap must be preserved between large shipments and the overhead trolley wire. If this gap is not maintained, the high-voltage current may jump from wire to cargo and cause a ruinous short circuit. To pass through bridges and tunnels, the trolley wire has to dip down perilously close to the train, *(Continued on page 250)*



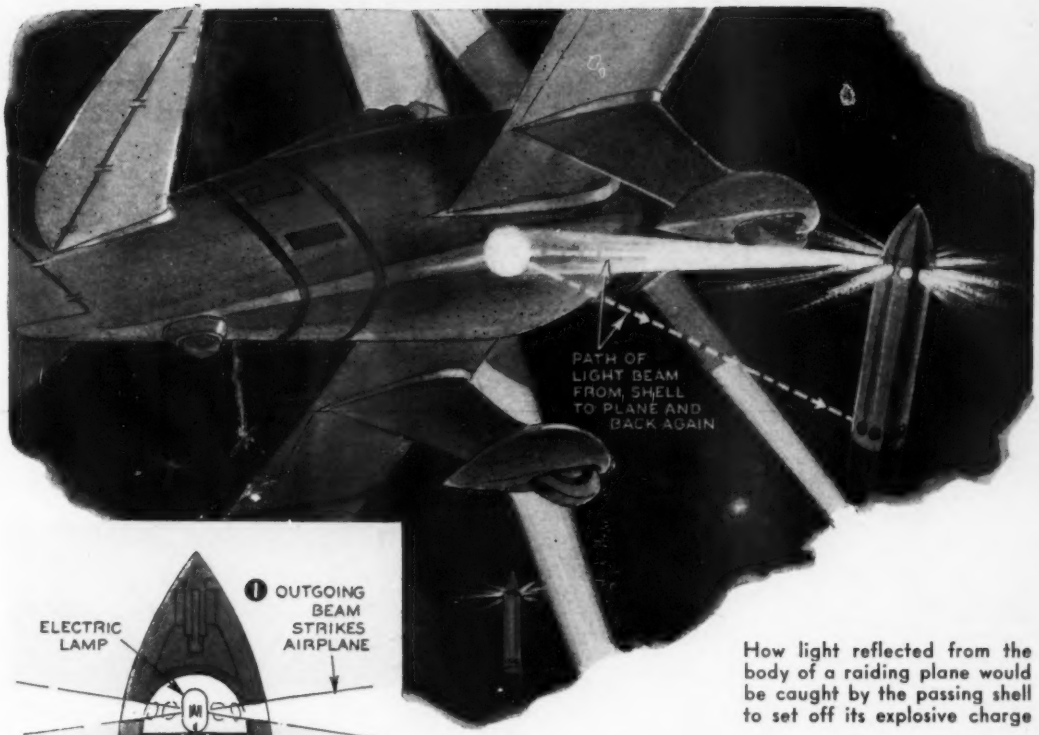
Pennsylvania Railroad clearance car measuring side room on a bridge and, at left, in a rocky cut. Wooden "feelers," attached to a frame erected on the car, gauge the distance from a point midway of the track

New Motorized Aquaplane Is Speedy

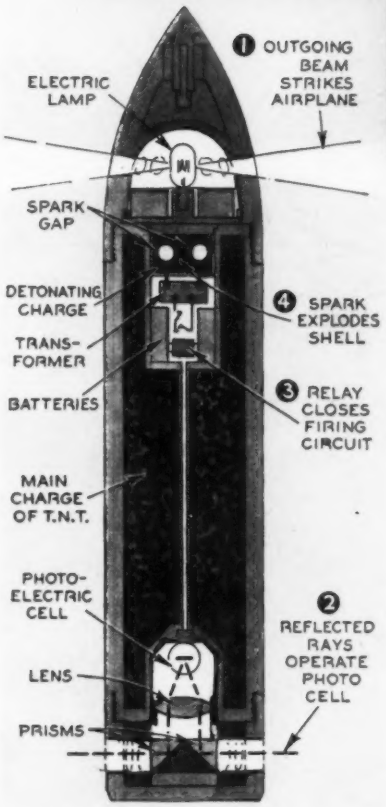
YOU need no tow to enjoy the thrill of riding a gasoline-powered aquaplane, latest innovation in aquatic sports (P.S.M., Nov. '38, p. 109). One of the fastest of the new self-propelled scooters, pictured below, skims over the water at twenty-five miles an hour under the power of a four-horsepower inboard motor. Its fittings include a remote-control gas throttle that can be operated from a standing position, a bilge pump, and a gasoline tank of two-gallon capacity. Twenty-six watertight compartments are declared to make it unsinkable. The motorized aquaplane is illustrated out of water to show the keel, propeller, and rudder.

Stern view of power aquaplane, raised out of water to show keel, rudder, and propeller

Electric Eye Fires Aerial Shell



How light reflected from the body of a raiding plane would be caught by the passing shell to set off its explosive charge



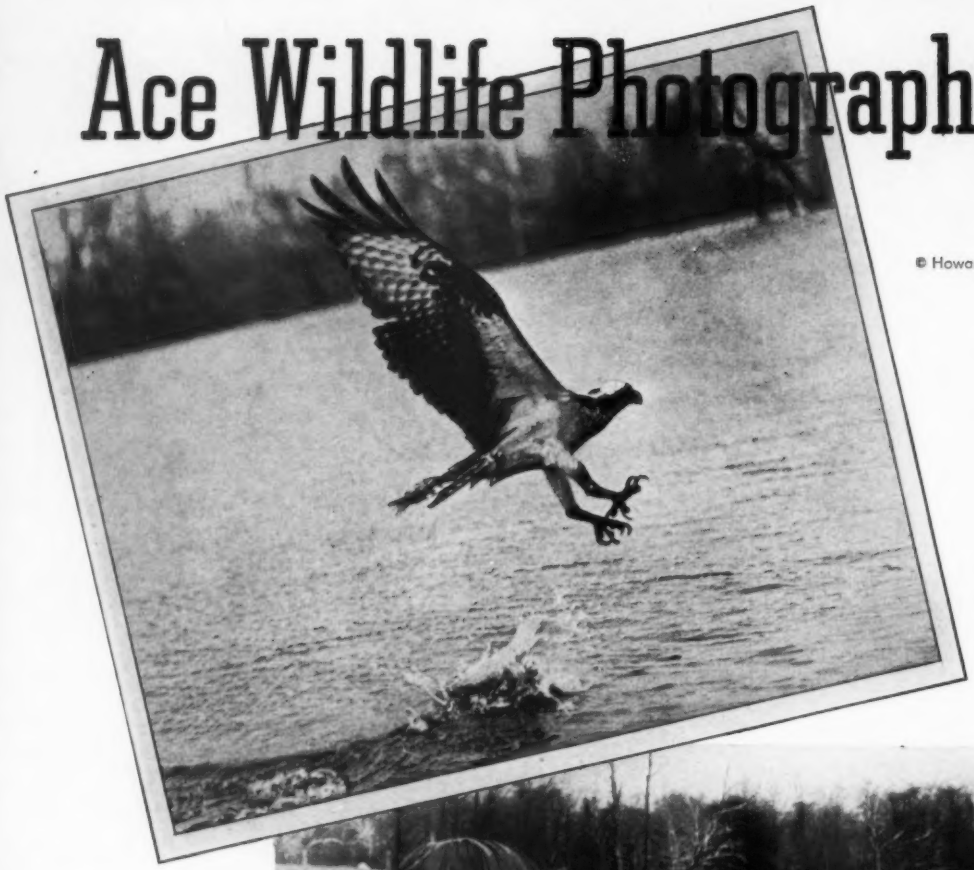
This diagram shows construction of the new antiaircraft projectile. It does not have to score a direct hit

AUTOMATICALLY exploded by an electric eye as it hurtles past its target, an antiaircraft shell reported under development in Sweden offers a potent new threat to air raiders. To cripple or destroy a bombing plane, the missile need merely pass near it, according to information received in this country.

During the flight of the shell, portholes in its nose emit rays of light from a powerful electric lamp. Beams that fall upon the body of an airplane are reflected to similar portholes in the base of the projectile, and are concentrated by prisms and a lens upon a photo-electric cell. This actuates a relay to close an electric circuit that explodes the detonating charge, and, in turn, the main charge of high explosive — at the exact moment when the bursting shell can do greatest damage.

Through an ingenious refinement of design, the projectile can be used against planes in full daylight as well as by night. Its electric circuit is so tuned as to respond only to rapid intermittent flashes of light, such as are produced by its own rotation in flight. Hence it can be set off only by reflection of its own light beams from a plane, and not by sunlight or lamplight. If it misses its mark by such a wide margin as to fail to explode, an auxiliary time fuse explodes it as it descends.

Ace Wildlife Photographer



© Howard Cleaves

It took Howard Cleaves three years to get this famous photograph of an osprey rising from a strike. He used the decoy goldfish and camera blind seen at the right and below

HE HAS descended in a water-tight tank to film diving ducks in action. He has cruised 250 miles over the Florida Everglades in a blimp to photograph wildlife below. He has crouched night after night for more than a week in a steel barrel on the edge of a forest clearing to record flash-light pictures of wild bears.

For more than a quarter of a century, Howard Cleaves, of Staten Island, near New York City, has been a wilderness cameraman. He has traveled more than 50,000 miles, from Labrador to the South Seas, to get his pictures. And, counting the individual frames of his movies, he has snapped upwards of 1,000,000 wildlife photographs.

If a stone, tossed aloft by a boy on Staten Island in 1906, had not glanced off a telephone wire, Cleaves might never have done any of these things. He was the boy and

Brings 'Em Back on Film

HIS STUDIO THE WILDERNESS, HOWARD CLEAVES HAS MADE 1,000,000 NATURE PICTURES

By EDWIN TEALE

For night work, a slender flash light taped to the side of the movie camera helps in making adjustments

• •

the wire supported a baby kingfisher. The sudden jar sent the bird tumbling to the ground. Young Cleaves carried the stunned creature home and a neighbor, who owned a camera, let him snap its picture. That early photograph started him on his adventurous career.

The success he has had in bagging creatures of the wild on film has been achieved through a unique combination of daring, patience, and mechanical ingenuity. One of his many innovations is a "diving suit" for his camera. This water-tight box, with powerful floodlights on either side, can be lowered at the end of a steel cable to obtain submarine shots. The camera, focused through a plate-glass window, is operated by remote control.

At Silver Springs, Fla., in 1937, Cleaves descended in a metal tank, four feet

Here the wilderness photographer is assembling his portable generator and lamps beside his special trailer

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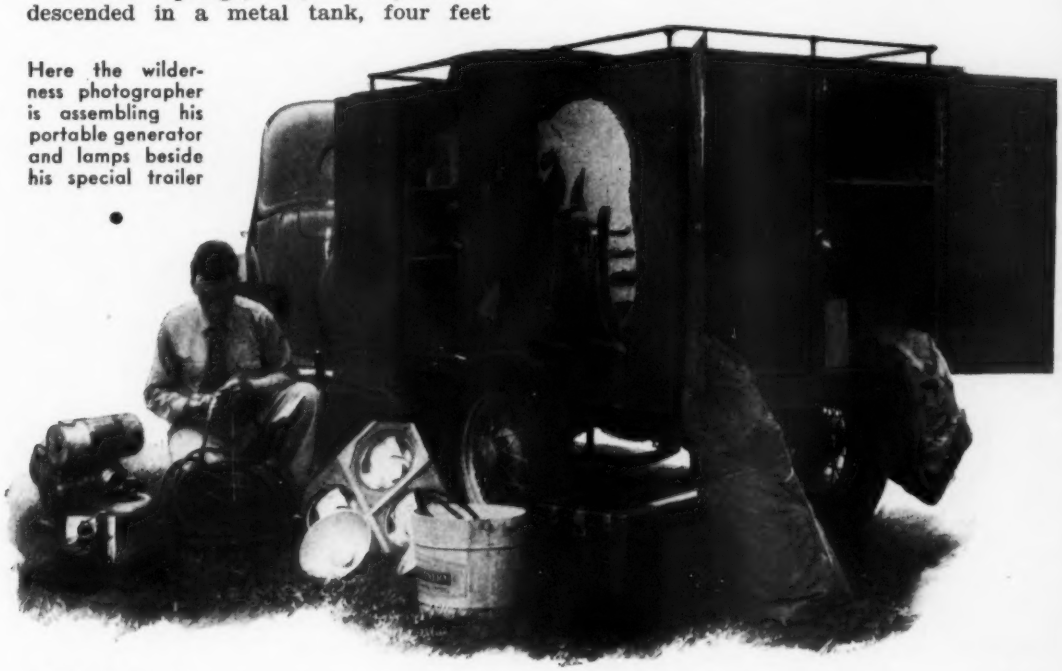
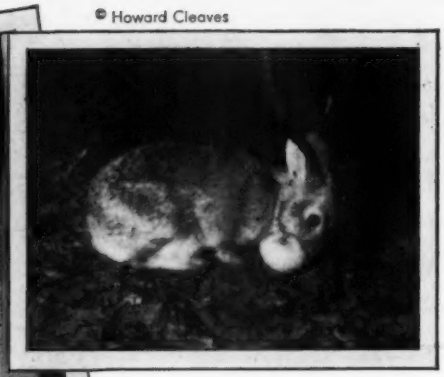


© Howard Cleaves



© Howard Cleaves

A cottontail rabbit baited with an apple. Left, a wild black bear snapped while it licked honey from its lips

square and seven feet high, when he filmed the underwater actions of wild ducks. Beforehand, he went down with a diving helmet and sprinkled cracked corn, wheat, and dried peas along the bottom. His film, the first of its kind ever made, revealed that these waterfowl paddle with alternating feet when swimming along the surface but use both feet in unison when diving for food.

Another mechanical aid of Cleaves's is a special attachment for one of his movie cameras. It permits him to switch quickly from distance shots to close-ups. For night work, he has a slender flash light taped to the side of his camera. It enables him to see when making adjustments in the dark. He is the first man in the world to take night movies in the wild by means of a portable generator and photoflood lamps.

Cleaves loading a shoulder pack with batteries that operate a powerful light he uses in taking some of his amazing night photos

One of his early experiences with this outfit resulted in seventy-five feet of film recording what is pretty close to the queerest movie on earth. He had focused his camera on a bear trail in the Appalachian Mountains and had dumped a gallon of peach marmalade on the path to attract the animals to the spot. Late at night, he heard one of the great brutes lapping up the marmalade. Switching on the lights, he started the camera. The beast paid little attention to the glare and Cleaves exposed seventy-five feet of film before it disappeared in the woods. Later, he discovered he had slipped up on the exposure. The movie was perfectly black except for a white spot that came and went in the center of the picture. It was the light-pink tongue of the invisible bear lapping up marmalade!

Complete with fuel for the single-cylinder engine, Cleaves's generator weighs less than 100 pounds. When the motor is spinning at 2,500 revolutions a minute, the compact little outfit supplies sufficient

current to keep three big photoflood lamps burning. By their light, a man could read a newspaper at a distance of 200 yards.

Only on dark, moonless nights can Cleaves take his photoflood pictures of wild subjects. If they see him, even dimly, they shy away. He had a curious experience of the kind in Florida. Mounting his lights at the bow of a small boat, he cruised about, filming the eerie night life on the edge of the Everglades. Water moccasins writhed along, swimming far out from shore; huge water beetles slapped against the lights; bats zigzagged in and out of the glare. At one point a brown pelican was perching on the gray stub of an old tree. The boat, with its brilliant floodlights, drifted to within six feet of the bird without alarming it. Then, as an experiment, Cleaves turned the beam of a small pocket flash light on his face. The instant the bird saw the human countenance, it flapped away in a panic!

Many times, Cleaves has gone into the Everglades on filming expeditions. But, in 1937, he got his first aerial view of that vast wilderness of sawgrass, muddy lakes, and hummocks. For five hours, he rode a lighter-than-air blimp above the swamp, photographing the strange wildlife below. Snapped from above, pictures of nesting flocks of birds showed back patterns never photographed before. At one place, Cleaves spied a huge alligator lying motionless near a mangrove thicket waiting for baby ibises

© Howard Cleaves

Tree swallows roosting at night on tall grass in a New Jersey swamp

© Howard Cleaves

Canned salmon was the bait that drew this raccoon and skunk within range of Cleaves's lights and camera

© Howard Cleaves

Br'er Fox caught in the act. Patience, skill, and ingenuity get results for Cleaves

to fall from the nests of a colony of these water birds. As the shadow of the blimp passed over it, the reptile rushed away in a panic, leaving a long wake in the mud and water.

Almost everywhere that Cleaves has gone, whether it has been the South Seas or the cormorant cliffs of Labrador, new pieces of equipment have been devised to aid him in his work. In preparation for the Labrador trip, for example, he designed a rounded "igloo" blind in which to hide and snap his pictures. The demountable bamboo framework is fitted together by means of short lengths of brass tubing.

For work in a wood or a pasture, Cleaves covers the framework with a "magic carpet" of imitation grass, tinted green. So realistic is this covering that several times, while he has been crouching inside waiting for wild subjects to come within range of his camera, cows have approached and tried to eat the "grass" from the covering!

The first picture of Cleaves's that attracted wide attention was a snapshot he obtained by three years of planning and the use of a mechanical goldfish.

The wilderness photographer assembling his portable blind. It consists of a collapsible bamboo frame and a cover of imitation grass

To get underwater pictures of diving ducks, Cleaves first went down in a diving helmet to scatter food, as below. Then he filmed the action from a tank

For two weeks each spring, fish hawks, or ospreys, used to come to a small pond on Staten Island to hunt golden carp before their regular sea-food prey came north. Cleaves set up his blind on the shore and waited day after day, hoping to catch one of the magnificent birds rising from a strike. All the action that year took place too far away to photograph.

The next season, he whittled out a crude imitation fish and anchored it near the blind. This decoy, however, failed to fool the birds. The third year, a friend of his at the American Museum of Natural History made a mechanical carp of wood, celluloid, and glass so designed that a tug on a black linen thread would make it wiggle realistically in the water. With this decoy in place, Cleaves waited in his blind, camera ready. A large osprey, beating down the shore in a light wind, spied the wiggling fish, swooped, struck, dropped the decoy, shot upward with a scream of rage. Cleaves clicked his shutter at the precise instant to catch on film what has been called one of the greatest bird pictures ever taken. That 1/100th-of-a-second snapshot, that took three years to get, has been published time and again both here and abroad, has been used in textbooks, and has even served as a model for painters.

The fastest action Cleaves ever filmed was the leap of a frightened deer in the mountains of western Pennsylvania. Years ago, an oil well was abandoned in the region after quantities of salty water had been pumped out on the ground. Deer came from miles around to use the place as a salt lick. With 250 feet of rubber-coated cable stretching from his generator, hidden in a thicket, to a huge moldering log, Cleaves set up his lights and camera. Hiding behind the log, he waited night *(Continued on page 246)*

With his battery of lights mounted in a small boat, Cleaves cruises about making wildlife night movies

Fishing Boats CARRY PIGEONS AS Winged SOS

HOMING pigeons take the place of radio for emergency communication on fishing boats working out of the harbor of Freeport, Long Island, N.Y. The boatmen's association at that coastal town maintains a flock of over 100 birds in a spacious, airy coop near the docks. Most of the fishing boats are not equipped with radio, so each craft takes on a crate containing a pair of the birds as it puts out to sea. Each bird has a tiny metal receptacle fastened to its leg, in which an emergency message can be placed. In case of fire, injury, sickness, or other emergencies at sea, the pigeons are released from the boat to fly back to Freeport with a written request for help. In many cases, they have brought timely aid to parties in distress.

At top of page, a pigeon is being released from a boat

Above, a boatman receives two birds in a cage before putting out to sea

Right, winged messengers waiting in their coop for the next call to duty

Charged with static electricity, wand repels plane

Wand Controls Planes in Scientific Toy Kit

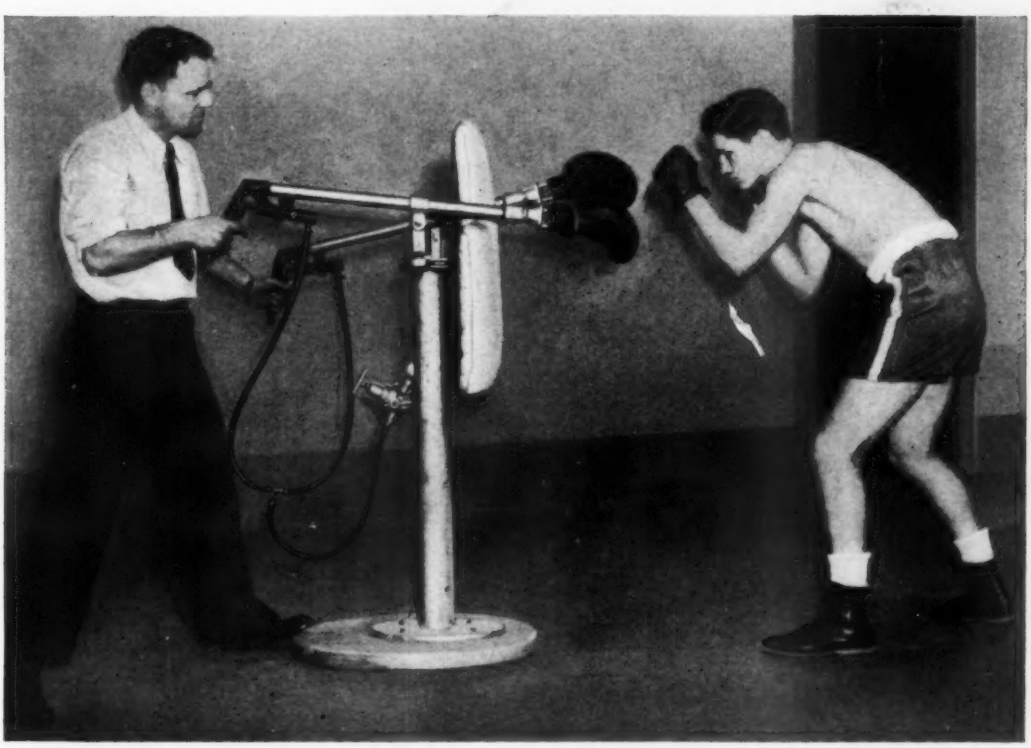
TINY model airplanes made of aluminum foil soar, dip, and turn in response to the waving of a "magic" wand furnished with a novelty toy kit now available. The wand, made of black hard rubber and fitted with a metal tip, is rubbed with a piece of wool, thereby taking on a charge of static electricity. When the metal tip of the wand is touched against the model plane, the latter assumes a similar charge and is repelled.

New Airplane Fuel System

SWITCHING automatically from an empty gasoline tank to a full one, a new fuel system developed by U. S. Army Air Corps engineers eliminates the danger of engine failure when the pilot is too busy to make the change.

Mechanical Boxer Packs a Mean Wallop

COMPRESSED air supplies the punch behind the mechanical fists of a novel boxing machine just developed by Frederick Westendorf, of Gary, Ind. Designed to provide boxers with practice in dodging and blocking blows, the mechanism is controlled by an instructor who operates gunlike triggers to fire the mechanical fists at a human opponent.



Boxer trading punches with the practice machine. Compressed air drives the gloved "fists" of the device

Large Tin Funnel and Oil Can Form Homemade Diving Helmet

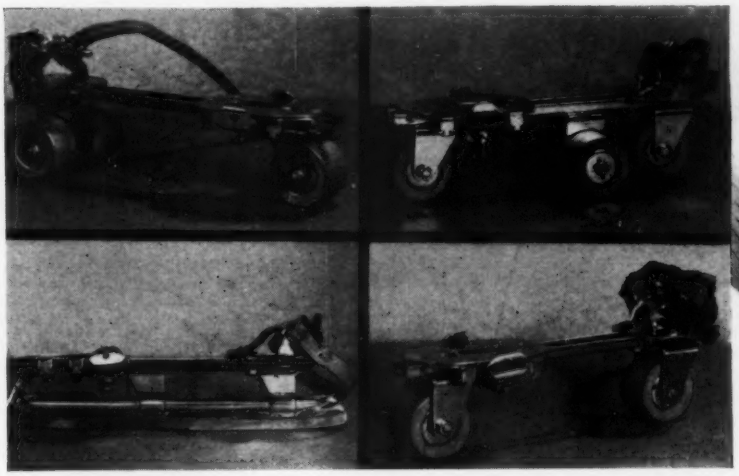
EMPLOYING two automobile tire pumps, an inverted funnel, and a five-gallon oil can, a group of amateur divers in Oregon constructed the odd diving outfit pictured on this page. The two pumps, located at opposite ends of a long board, are operated by a single handle, each pump forcing air into the helmet at alternate strokes. Ordinary garden hose delivers the air into the top of the inverted funnel, which is soldered to the top of the tin-can helmet. Used air is exhausted through an opening between rubber padding at the base of the helmet and the shoulders of the diver. Weights and a piece of sacking tied under the arms of the user hold the homemade helmet in place. A safety rope is tied around the diver's waist, for pulling him in if trouble develops.

Amateur diver ready for a dip. The helmet is a tin can with a funnel soldered onto the top

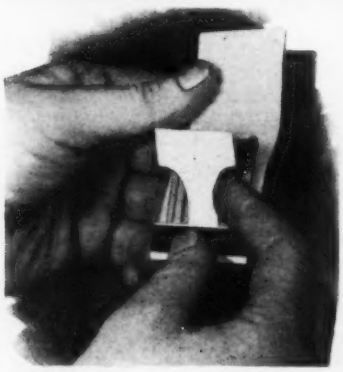
While one man works the handle of a homemade pump, another pays out the safety rope and garden-hose air line. At left, diver is completely submerged

Ice and Roller Skates Combined

ROLLER SKATES and ice skates ingeniously combined into one adjustable unit are now available to skating enthusiasts. With a tubular blade attached to its adjustable steel chassis, the device serves as an ice skate. When the blade is removed, rollers may be attached in several different arrangements to form a two, three, or four-wheeled roller skate. Some of these combinations are illustrated in the photographs reproduced below.



Skates may be used on ice, or with two, three, or four rollers, as illustrated in the photographs at the left



Novel Safety Flap Shields Matches

DESPITE the fact that most paper-match books carry a printed warning to close the cover before striking a match, many accidents still occur when sparks from an igniting match fly back to set off the remaining matches. To prevent this, a new type has a paper safety flap that covers the match heads at all times to shield them from sparks.

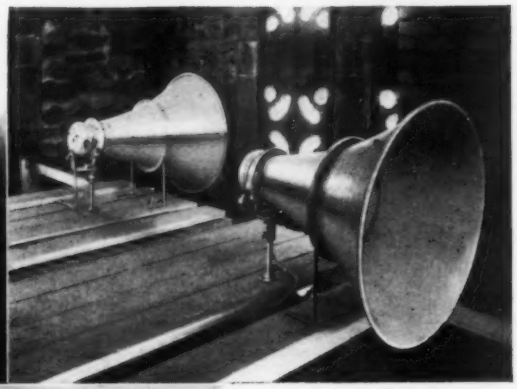
Conveyor on Truck Delivers Coal

COAL is delivered into home or factory bins without shoveling, dumping, or hand carting, by trucks equipped with a new conveyor-belt attachment. Operated by the truck motor, the unit consists of an eight-inch rubber belt that can be adjusted to carry coal to either side of the truck body into elevated or out-of-the-way bin openings. With an auxiliary chute, it may be used to clear an intervening fence or hedge. Hinged baffle plates and extension sides prevent spilling.

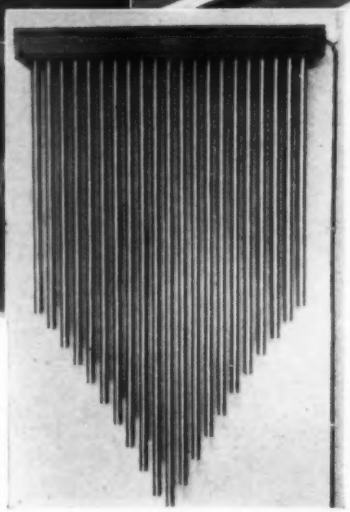
Conveyor unit built into truck delivering coal to elevated bin opening

Electric Carillon Has No Bells

A keyboard in the console of the organ operates the small chimes electrically



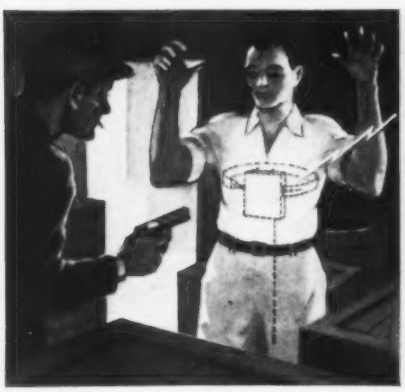
Two of four big speakers set in a church belfry to broadcast the chimes



Twenty-one chimes, less than five feet long, give the carillon its tones

CHURCHES unable to afford a costly carillon can now avail themselves of an inexpensive substitute, with the introduction of a loudspeaker system, designed by Francis J. Rybak, organ specialist, that closely simulates the majestic tones of massive bells. Using a small keyboard mounted on an organ console, the "bell ringer" plays a set of twenty-one tubular chimes, of the type used in orchestras, ranging up to a maximum of five feet in length. Their sound, electrically picked up and magnified to enormous volume by a vacuum-tube amplifier of new design, issues from four powerful loudspeakers in the belfry. In an installation in one eastern city, the synthetic carillon can be heard over an area of ten square miles.

Concealed Radio Transmitter Sends Holdup Alarm



By taking a deep breath, the victim starts transmitter to send alarm

WITHOUT endangering himself by any telltale move, a victim of a holdup may sound an alarm, with a radio outfit devised by a Chicago inventor. Designed especially for bank employes, payroll carriers, and night watchmen, the device is completely hidden beneath the user's clothing. To call for help, he has only to take an extra-deep breath. A band encircling his chest closes an electrical circuit, and a tiny automatic transmitter flashes a string of alarm signals to a central receiving station.

Sculptor Turns Lard into Pigs

WITH lard as his medium, a prominent Chicago sculptor, Charles Umlauf, recently executed one of his strangest commissions. The result of his labors was a piece of statuary from which a big pig and a little one grinned at visitors to an international livestock exhibition. More than 500 pounds of pure lard went into the making of the novel work of art, to which the sculptor is shown applying the finishing touches in the illustration at the right. The photograph also shows some of the unconventional tools that he pressed into service, including a trowel-shaped implement, a large wooden scoop, and a set of smaller scrapers for more delicate modeling of the unusual group.

Reversing the usual process, sculptor Umlauf made these pigs out of lard

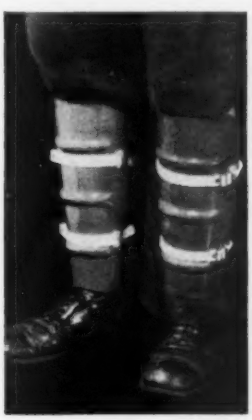
Only a coin or the owner's key releases the dial

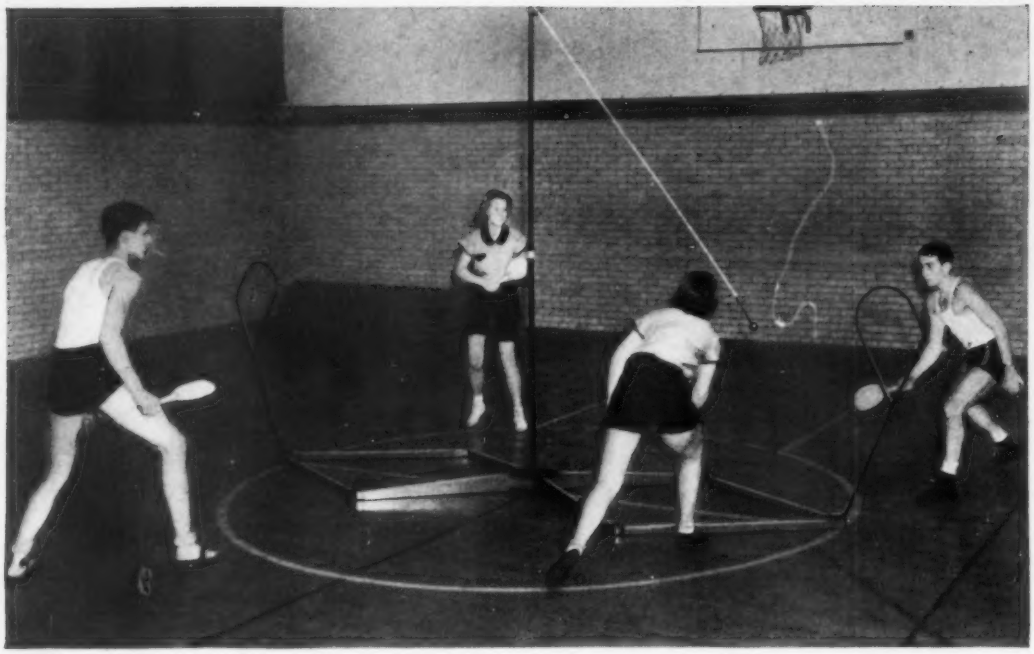
Coin Unlocks Dial Phone

THRIFTY telephone subscribers who like to pay as they go, or whose good nature is imposed upon by "chiselers" to make free phone calls, may welcome a new coin-box lock attachment for dial instruments. A metal arm locks the dial until the user drops a nickel in a slot, or the owner inserts his private key.

Shin Guards for Workers

STRAPPED on over shock-absorbing pads of sponge rubber, fiber leg guards of new design save industrial workers from barked shins. Ribbed for strength, the guards may be worn either outside or under the clothing, as illustrated at the right.





Ball Knocked for a Loop in Novel Game

A HEAVY sponge-rubber ball, suspended on a cord from an upright, provides fun and action in a new tennis-type game. Using wooden paddles, opposing players try to score goals by batting the ball through either of a pair of loops supported by standards. The illustration above shows four players using gymnasium-size apparatus. Smaller equipment is available for lawn use by two players, and for a miniature table-top adaptation.

Gearshift-Lever Switch Operates Turn Signal

RIGHT and left turns are signaled from a convenient control set on the knob of the gearshift lever, with a combination tail light, stop light, and directional indicator of new design. A pilot light on the knob shows when the warning is operating, and the cable leading from the lever has sufficient slack to avoid interference with gear shifting. For owners of new-model cars with the gearshift mounted on the steering column, a similar control is available. Mountings of both types are shown at the right.

Signal switch on steering-post gearshift lever and, upper left, on floor-type lever. Circle shows light

Gas Kills Bugs in Apples

INSECTS feeding inside apples are killed by fumigation with methyl bromide, tests by Canadian Government scientists have shown. While deadly to insects, the substance leaves so little residue in the flesh of the fruit that it is harmless for human consumption, according to the experts' report.

Camera Dissects Golfer's Swing

BY "chopping time up into small bits and freezing it," a new ultraspeed lamp for photographers produced this remarkable picture of a golfer striking a ball. Successive images, made on the same film at the rate of 600 a second, reveal the progress of the swing from the top of the stroke to the end of the follow-through. Notice how the fewest images appear near the bottom of the swing where the club attained its greatest speed. The new filming method, known as "multiple-flash photography," is the latest refinement of stop-motion technique developed by Prof. Harold E. Edgerton of the Massachusetts Institute of Technology. In taking the picture, the camera shutter remained open all the time, each image being made by a 1/100,000-second flash of the new lamp.

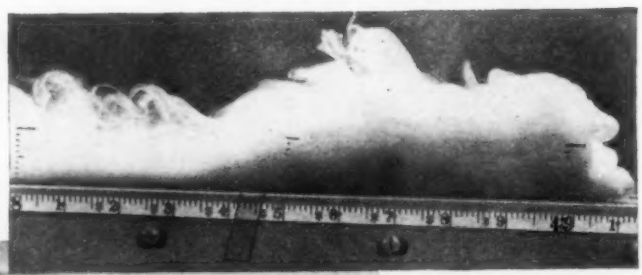
Radio Sound-Effects Kit

DISTANT thunder, the patter of rain, screaming sirens, crackling flames, train whistles, and a number of other noises can be simulated with a novel sound-effects kit recently introduced for radio-minded youngsters. The outfit includes a siren, whistle, sounding-board box and sand blocks, sheet of tin, and other items. Also provided in the kit is a miniature set of chimes tuned to the pitch of those used on a national radio network.

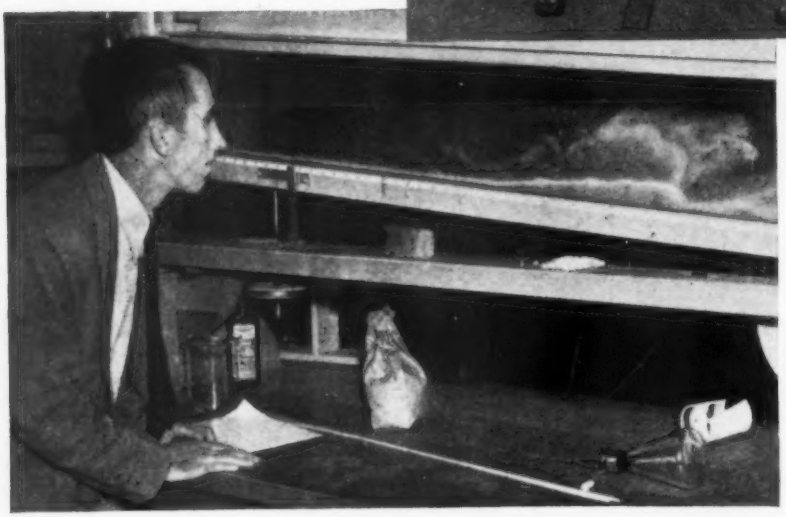
Everything from thunder to train whistles can be duplicated with this new toy

Silt Deposit Studied in Model River

TO STUDY what happens when the Colorado River runs wild in flood stage and deposits millions of tons of sediment in the gigantic artificial lake backed up by Boulder Dam, scientists at the California Institute of Technology have set up a novel viewing tank for sedimentation experiments. Over six feet long but only a few inches wide, the glass-walled tank has a sloping bottom simulating the bed of the Colorado River. When silt is introduced into water flowing into the tank, observers can watch it closely as it settles gradually to the bottom. In the photograph below, an assistant is checking the deposits.



Scales along the side of the glass-walled tank allow laboratory silt formations to be measured easily and accurately

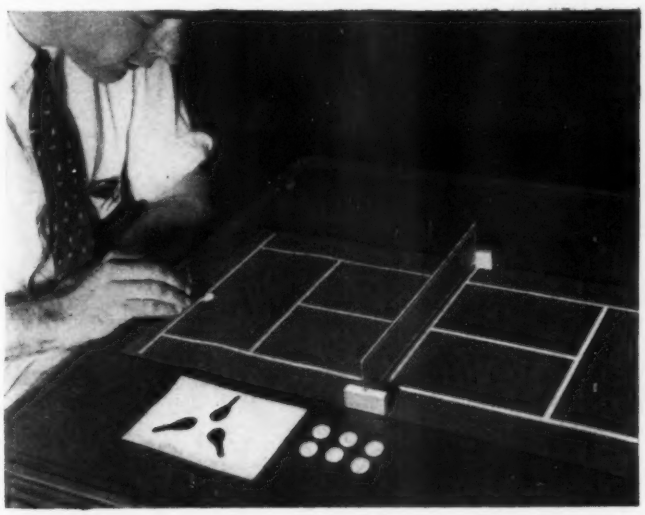


By studying the action of "silt" in this scale-model river, experts can gauge just how much dirt will be deposited in Boulder Dam lake by the Colorado River under various conditions

Snowmobile Aids Foresters

MOUNTAINOUS terrain buried under deep snow, hitherto impenetrable by any type of motor vehicle, is opened up by an ingenious snow tractor designed by T. P. Flynn and Raymond E. Neils of the U. S. Forest Service. Gasoline-powered, the endless-tread tractor draws a boat-shaped sled attached to it by means of a turntable to permit making sharp turns without upsetting the sled.

Loads like this are easily hauled through snow-covered mountain country by the odd snow motor pictured at the top of the page



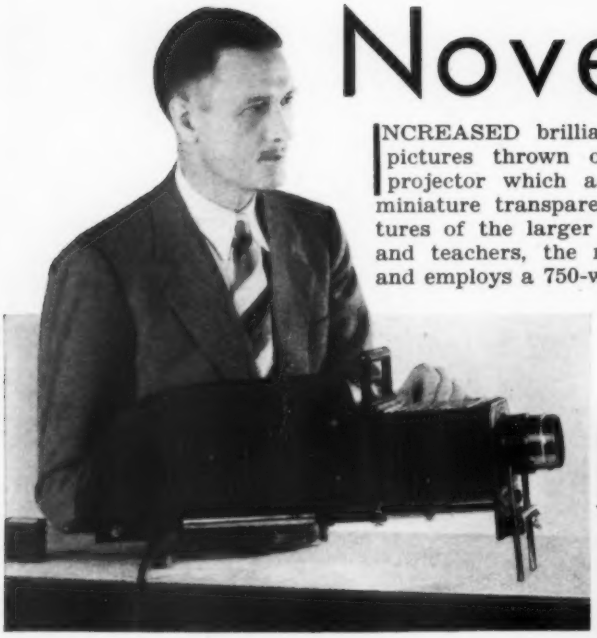
Thin disks are snapped across the "net" with miniature rackets

New Table Game Resembles Tennis

TIDDLEDYWINKS and tennis are combined in a novel parlor game just introduced. Played on a felt pad measuring twelve by twenty-four inches and marked with white lines as on a real tennis court, the game uses thin disks which are snapped back and forth across a diminutive net by means of tiny rackets. Rules and scoring are similar to those used in tennis. In the photograph reproduced at the left, a player is shown about to serve from the back line of the court. In the foreground are the rackets and the "balls" used.

Novel Ideas

INCREASED brilliance is said to be imparted to color pictures thrown on an auditorium screen by a new projector which accommodates either the 2 by 2-inch miniature transparencies or the 3¼ by 4-inch color pictures of the larger cameras. Manufactured for lecturers and teachers, the new outfit weighs twenty-one pounds and employs a 750-watt lamp.



This projector throws brilliant color images on a screen

Full-Color Duplicates Made of Kodachrome Movie Reels

SIXTEEN - MILLIMETER Kodachrome movie films can now be duplicated just as black-and-white reels have been in the past. New facilities at the Eastman Kodak Company, in Rochester, N. Y., permit the making of as many duplicates as is desired from an original full-color home movie. This new service enables the amateur to have extra reels made from original color movies which could not be rephotographed if they were lost.

Each "volume" will hold 100 natural-color transparencies

Bumper Fits on Finder To Protect Eyeglasses

"SPECTACLE BUMPERS" made of soft rubber now prevent eyeglasses from coming in contact with metal when amateur movie makers are peering through the spyglass-type view finder on a home movie camera. The cup-shaped rubber tip can be slipped on the view finder or removed quickly.

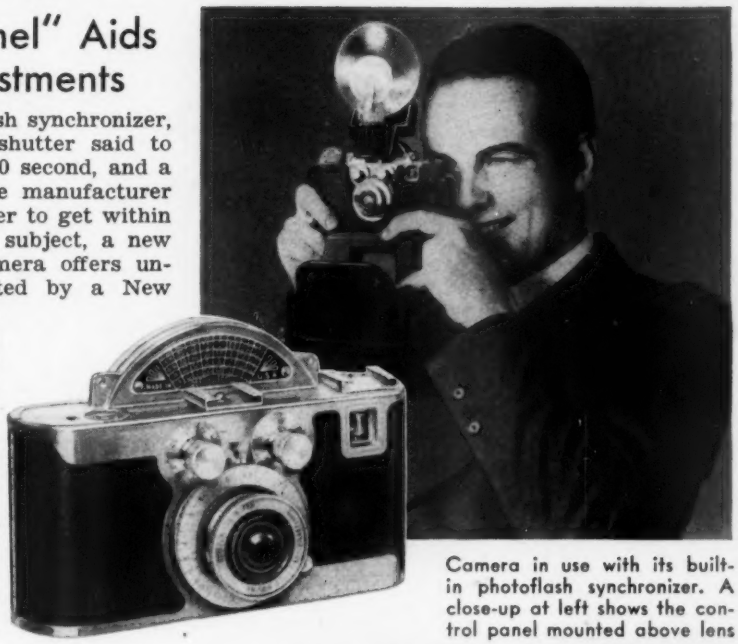
Dummy Volumes House Color-Slide Library

RESEMBLING fine old volumes with Florentine hand-tooled leather covers, new book-type filing boxes provide an attractive place in which the amateur can store miniature natural - color slides. Ten inches long, six and a half inches wide, and two and a quarter inches deep, the "books" hold 100 slides apiece.

for Camera Fans

"Instrument Panel" Aids Camera Adjustments

With a built-in photoflash synchronizer, an all-metal focal-plane shutter said to permit snapshots at 1/1000 second, and a focusing mount which the manufacturer reports will permit the user to get within a foot and a half of his subject, a new inexpensive miniature camera offers unusual versatility. Marketed by a New York manufacturer, the compact little outfit takes thirty-six pictures on a roll of thirty-five-millimeter film. All adjustments are made through controls mounted above the lens. An exposure calculator and a depth-of-focus scale, indicating how much of the picture will be in sharp focus, are located above the body close to the view finder.



Camera in use with its built-in photoflash synchronizer. A close-up at left shows the control panel mounted above lens

Tray Case Holds Accessories

OPENING to form a tray, a new-type case for miniature cameras provides extra convenience to the user. Made of leather and lined with velvet, in holds filters, lenses, and film. In use, it keeps all accessories within easy reach.

Filters, lenses, and extra film are kept within easy reach in this tray-type camera case

Kit for Table-Top Shots

TABLE-TOP photography of minute objects, such as insects, small stamps, bullets, and rock crystals, is facilitated by a recently marketed kit of attachments for an inexpensive miniature camera. The kit includes extension rings, supports, and a ruled focusing glass. Once the camera, pointing downward from the top of the four-legged support, is focused on an object, it can be used repeatedly without further adjustment.

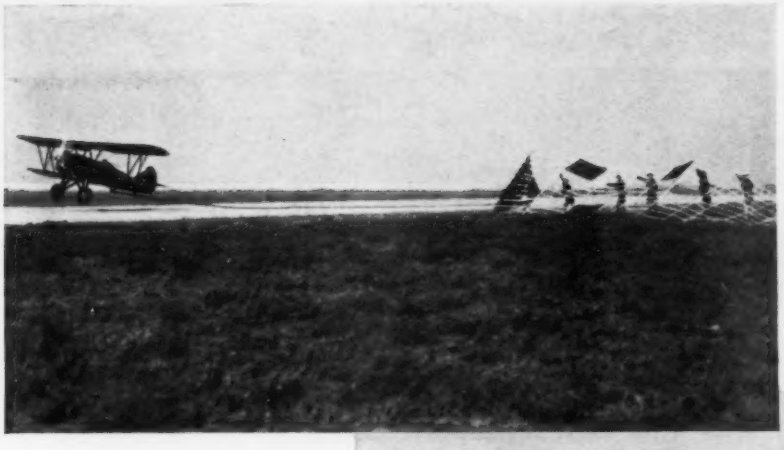
Planes Tow Electric Signs

RIDING high in the air above the skyline, a new kind of Santa Claus visited New York City last Christmas season. Millions of holiday makers thrilled to the sight of St. Nicholas, his sleigh, and his reindeer outlined against the night sky in sparkling electric lights, behind an unseen towing plane. The dramatic spectacle represented the latest development in aerial advertising —the illuminated sky sign.

Until recently, signs that planes have towed aloft have been visible by daylight only, resembling openwork billboards with solid letters. Intended to be viewed by night instead of by day, and therefore requiring an entirely different design, those of the new kind look more like the elaborate set pieces that top off programs of fireworks. How these illuminated signs are made and flown has just been revealed by the originators of the idea, the S. S. Pike Company, Inc., of New York, with the story behind their Santa Claus creation.

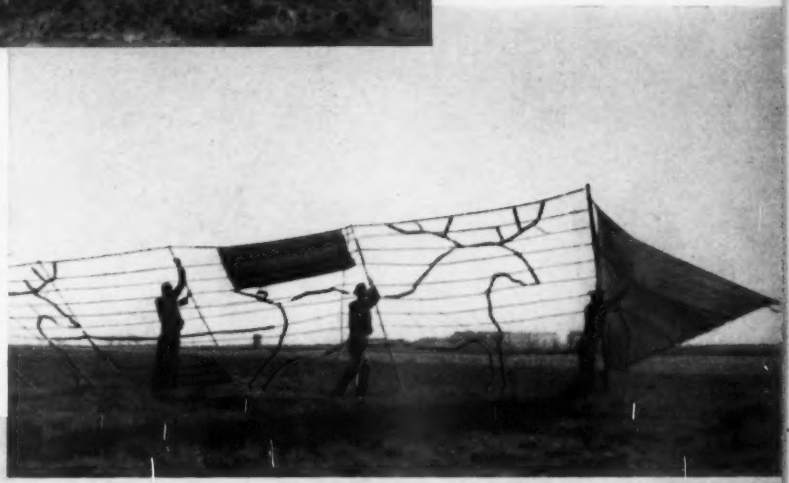
Power from the airplane's own generator supplied the current for more than 1,000 lamp bulbs in the Christmas display. Attached to the end of a 400-foot towrope, the sign itself measured 150 feet long and fifteen feet high. Its intricate wiring, if stretched out in a single length, would have measured 3,000 feet.

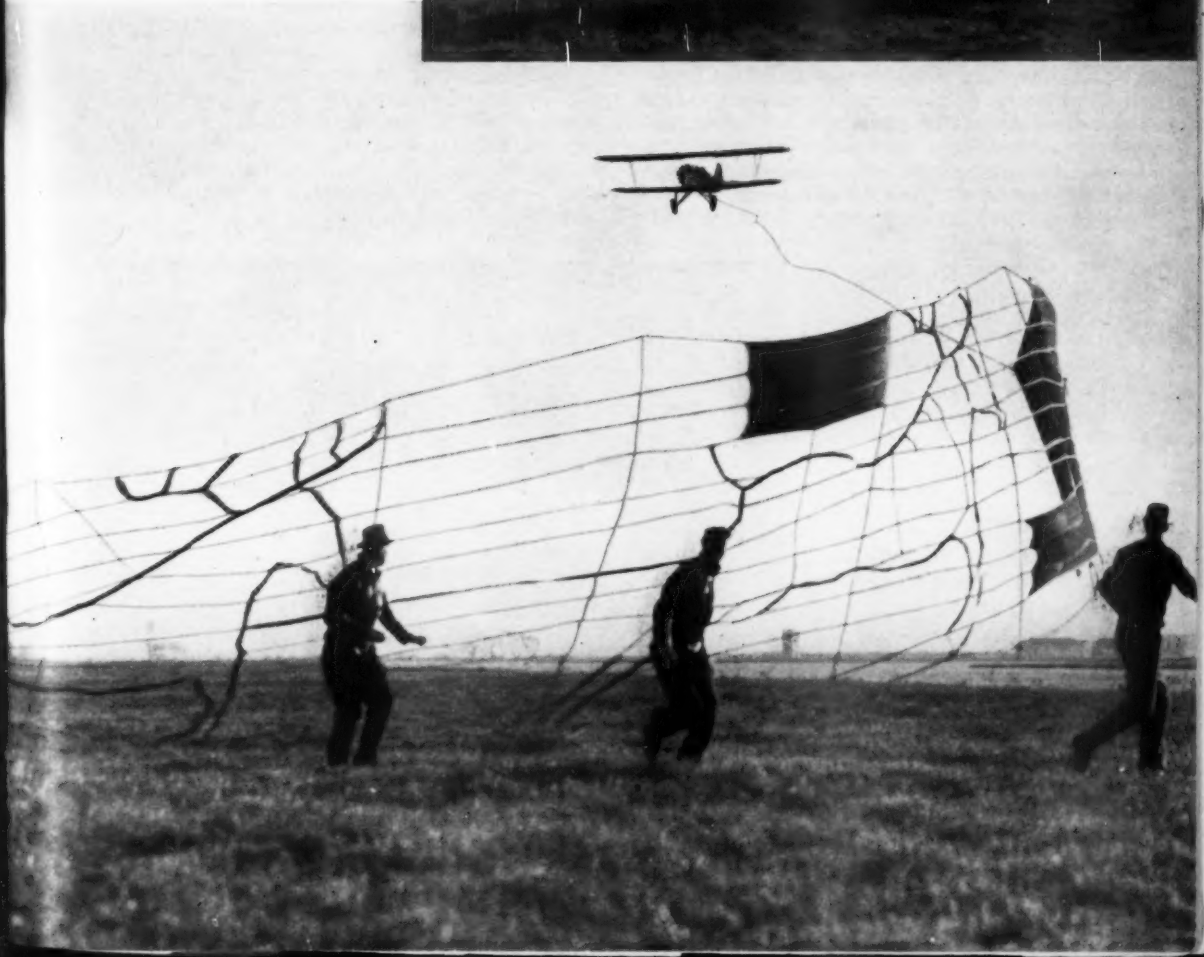
As the first step in constructing the sign, the makers fashioned a fabric webbing of the required total area, reënforced at intervals by transverse poles. To this backing, spread out flat on a hangar floor, they applied canvas strips in the outline of the reindeer, the sleigh, and its driver. With an artist's sketches for guidance, lamp sockets were inserted in



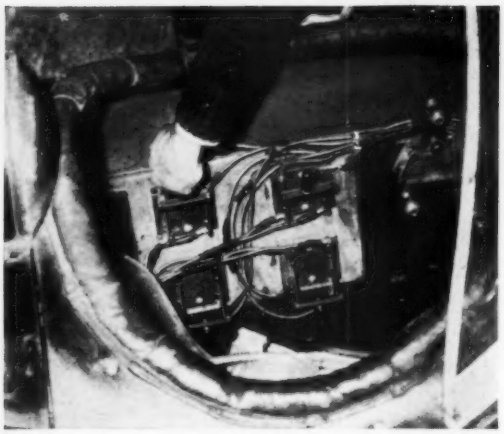
DAYLIGHT REHEARSAL SHOWS HOW THE "FLYING SANTA" WAS LAUNCHED INTO THE AIR

The plane takes off, pulling up the slack in the long towrope. At the right, the "ground crew" are holding the sign upright to keep it clear of the grass. They let go, below, as the sign is "peeled" from the ground. Photo on opposite page shows how the "flying Santa Claus" looked as it was towed past the New York City skyline





Inserting the 1,000-odd tiny light bulbs in the sign required several hours of slow, painstaking work



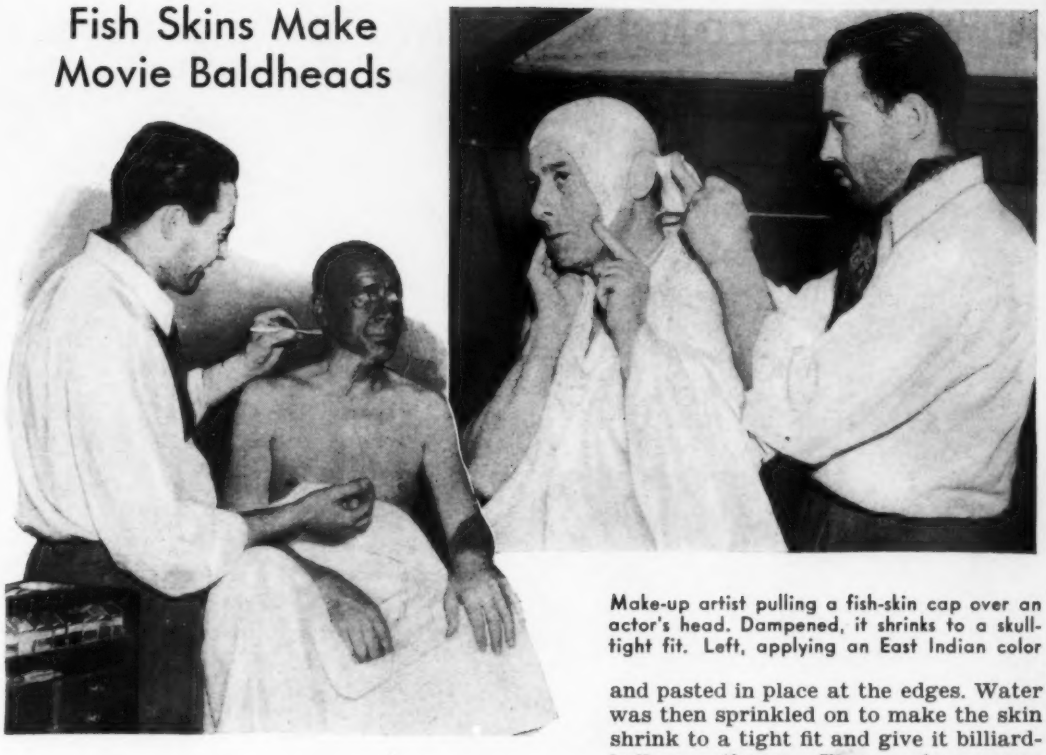
Four switches in the pilot's cockpit controlled the lights. Each figure had its own individual switch

the canvas strips at about one-foot intervals, and wired together. Inserting the powerful little lamps, hardly larger than flash-light bulbs, took one man several hours of painstaking work. Spliced to the towrope with pieces of tape, the main power cables were led from the sign to electric terminals beneath the plane. Before a take-off, an electrician tested all parts of the wiring with a voltmeter to make sure they were in working order for best results.

With the design and wiring of the sign completed, it remained to perfect the details of launching and flying it. Experience with daylight signs showed that the same general scheme of launching could be used. The standard method is to lay one of these signs flat on the flying field, leading the towrope first backward and then forward in a giant U to the plane on the runway. When the plane takes off, it first pulls up the slack in the U, and then "peels" the sign off the ground. Taking no chances of damage to the illuminated display, its creators added the innovation of a "ground crew" to hold it upright during the peeling-off maneuver. A triangular towing bridle of cloth with a streamline weight at the bottom, several patches of cloth placed strategically within the sign, and an air drag resembling a "wind sock" at its tail, solved the aerodynamic problem of keeping it steady and upright in the air. Just before a landing, it was cut loose to settle gently to earth. Daytime test flights with the sign, preceding its first public appearance, proved the complete success of the aerial display. According to its makers, the idea may be applied in electric advertising signs of every description, opening the startling prospect of a new "Great White Way" in the heavens, when the night skies above large cities may be alive with brilliantly lighted signs hiding the stars and rivaling the billboards of flame that line the crowded thoroughfares.

Connecting the power cable on the towrope with terminals under the plane

Fish Skins Make Movie Baldheads



Make-up artist pulling a fish-skin cap over an actor's head. Dampened, it shrinks to a skull-tight fit. Left, applying an East Indian color

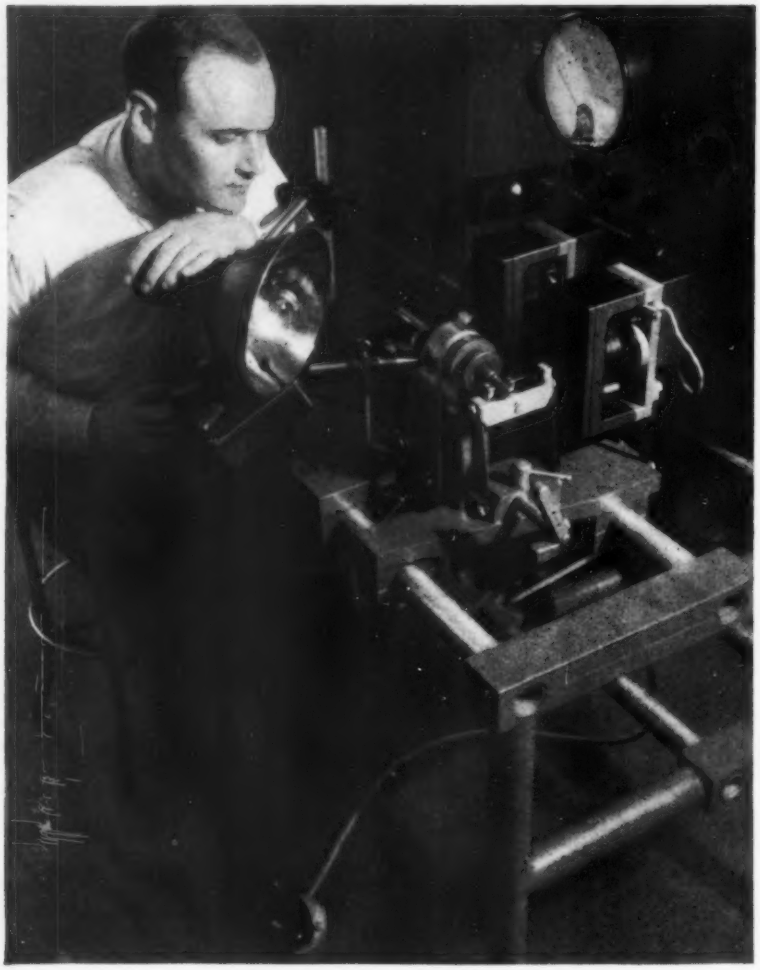
CREATING bald heads for actors from pickled mackerel skins and paint was one of the odd tasks performed by Hollywood make-up artists during the filming of the picture "Gunga Din." Shaped like a skullcap, a fish skin was drawn over each actor's hair and pasted in place at the edges. Water was then sprinkled on to make the skin shrink to a tight fit and give it billiard-ball smoothness. Then make-up was painted on with a brush as the final step in a process that required more than an hour. Eduardo Ciannelli, an actor portraying an East Indian, had to be painted daily from his "bald" head to his toes until his part in the movie had been completely filmed.

Homemade Incubator Holds Twin Babies

HAROLD SCHMIDT, St. Louis, Mo., clergyman, recently completed a unique home-workshop project: a homemade incubator for his twin, prematurely-born daughters. Because keeping the tiny infants in a hospital incubator involved too great an expense, the resourceful pastor built a double-compartment box, lined it with soft cushions and padding, and installed two heating elements consisting of rows of electric-light bulbs set into compartments at the ends of the box. When the lights are on, a constant temperature of eighty-five degrees is maintained within the incubator, shown at the right with the twin girls and their mother.

Electric-light bulbs keep this twin crib at an even temperature

Electric Brain Tests Motor Balance

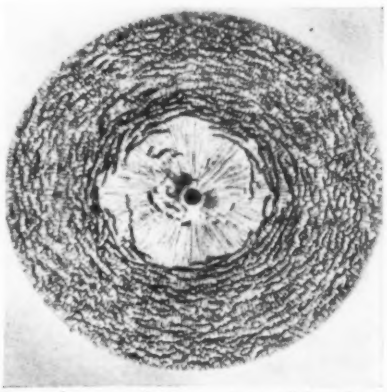


This sensitive machine "sees" and "feels" when motor rotors are off balance

TO ELIMINATE noisy and destructive vibration from the rotors of electric motors and dynamos, a testing machine of new design both "sees" and "feels" lack of balance, and prescribes the cure. Westinghouse engineers have applied the device successfully to rotors ranging in size from those of small household appliances to two-ton giants used in industry. In a vacuum cleaner, for example, vibration from an unbalanced rotor racing at 10,000 revolutions a minute may produce objectionable noise. To correct this, the rotor is spun in the testing machine, where magnets and an electric circuit register vibrations that are of as short length as only 2/100,000 inches. An automatic analyzer or "brain" then shows how much corrective weight to apply, and where. Meanwhile, a flickering light—in effect, a stroboscope—makes the rotor appear to stand still so that an observer can watch its performance.

Photo Shows How Glass Breaks

CRACKS travel through breaking glass at a velocity of nearly a mile a second, or more than 3,000 miles an hour, stop-motion photographs like the one at right have just revealed. The picture shows radial cracks growing outward in a piece of tempered glass, from a central point where a metal plunger has just struck it, while transverse cracks simultaneously converge toward the center. The plunger itself is seen as the black spot in the middle. Note that the pattern of cracks forms a virtually perfect circle, offering visual evidence that all the fractures grow at the same speed. Tests like these, conducted with the aid of high-speed photography at the Massachusetts Institute of Technology, Cambridge, are expected to lead to stronger and safer glass.



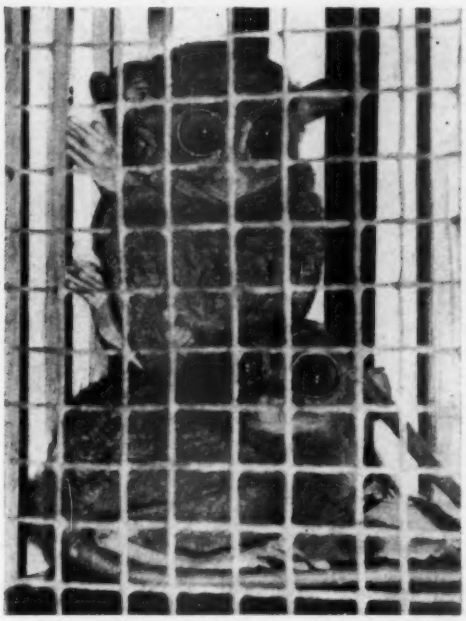
Spreading cracks in a piece of breaking glass, caught by the high-speed camera

Tree Is Carved into Statue

FROM a historic elm tree, planted by Hessian prisoners at South Windsor, Conn., during the American Revolution, sculptor Lawrence T. Stevens is carving a huge statue for exhibition at the New York World's Fair. When work is completed, the tree statue will be felled.

Rare Philippine Animals Cross Country by Air

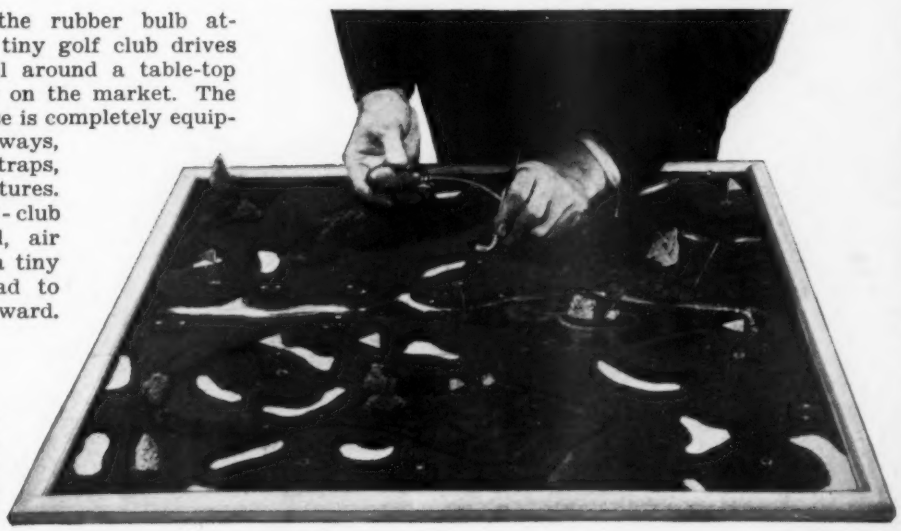
SAID to be the only specimens of their kind ever imported into this country, two monkeylike tarsiers recently arrived at Yale University, New Haven, Conn., after a journey from Surigao, Philippine Islands. Intended for use in research, they crossed the continent by air.



These are tarsiers imported from the Philippines

Air Drives Ball in Table-Top Golf Game

SQUEEZING the rubber bulb attached to a tiny golf club drives a miniature ball around a table-top golf course now on the market. The diminutive course is completely equipped with fairways, greens, bunkers, traps, and other features. When the golf-club bulb is pressed, air streams out of a tiny hole in the head to blow the ball forward.



Air from a rubber bulb attached to the handle of the tiny club drives a miniature ball

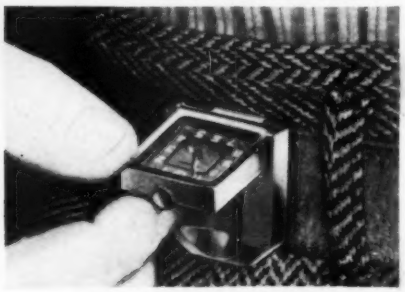
A Dutch business man parking his wheel before making a call

Cyclists Park Wheels in Sidewalk Slots

CYCLISTS of Amsterdam, Holland, park their bikes conveniently and safely in special sidewalk receptacles, like the one seen in the illustration at the left. Diagonal slots in the curbing hold the machines upright and out of the way of traffic. Common use of bicycles makes such an arrangement desirable.

Watch for Sportsmen Is Worn on the Belt

WORN where it is jarred least, a new "belt watch" is declared a practical innovation for sportsmen and others in active pursuits. A spring clip holds it firmly in place, and a flip of the finger tilts it up to read the time, as shown below.



After gazing at a bright light, as above, subject tries to see faint arrow at right

Instrument Gives Test for Night Blindness

WHEN you step from a sunlit street into a movie theater, your eyes need a few minutes' time to adapt themselves to the darkness. One person in ten takes an abnormally long time. He suffers from "night blindness," usually without knowing it, and may be a menace if he drives a car after dark. To detect such cases, a new test instrument shows how long it takes a subject to tell the direction of a faintly illuminated arrow, after gazing into a bright light. Since lack of vitamin A has been found to cause night blindness, a simple change of diet often brings about a cure.

Herman Sigg aloft in his glider. This remarkable photograph was made by a self-timing camera attached to a wing, as at left

Glider Fan Snaps Self in Flight

BY MOUNTING an ordinary camera on an outrigger at the end of a wing, a Swiss glider enthusiast, Herman Sigg, takes pictures of himself and his craft in flight. Before taking off, he sets the shutter at snapshot speed, and attaches the shutter release to a self-timer—a standard photographic accessory for making an automatic exposure after a predetermined number of seconds or minutes. By the time the shutter clicks, he is in the air, and the result is a photograph like the striking shot reproduced above. The picture shows Sigg soaring high above the countryside, with converging roads appearing as white lines visible in the foreground.

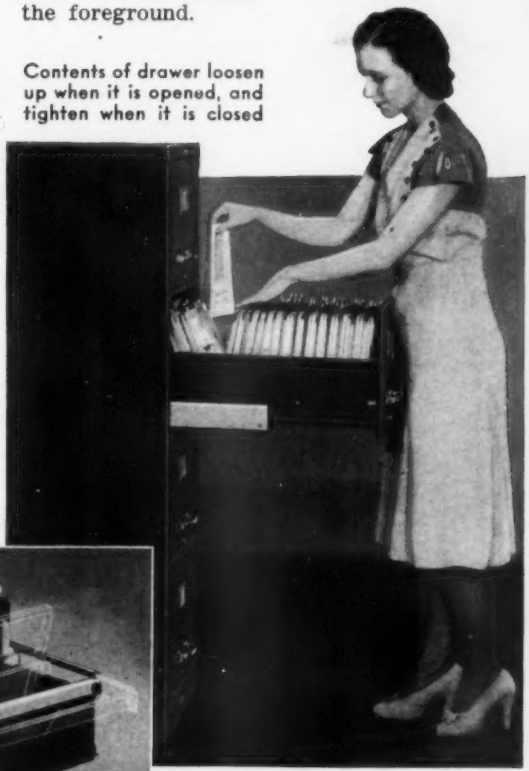
Whipper Quadruples Cream

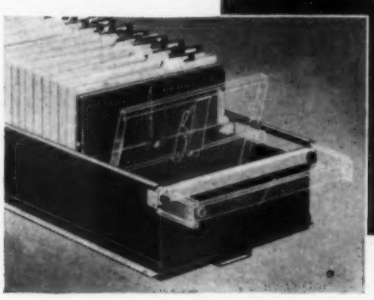
THREE to four pints of whipped cream are produced from a single pint of fresh cream, with a machine recently marketed in Germany. Operated by compressed air, the device impregnates the cream with air bubbles.

Self-Adjusting File Speeds Office Work

PULL open the drawer of a new filing cabinet, and the contents automatically loosen to facilitate insertions or withdrawals, falling backward at the best angle for easy reading. Close the drawer again, and the contents rise once more to a vertical position, as a sliding partition moves forward from the back of the drawer to take up the slack. Self-adjusting to suit any quantity of material in a drawer, the improved cabinet, pictured in the illustration at the right, eliminates the inconvenience of crammed or sagging files, and speeds up clerical work.

Contents of drawer loosen up when it is opened, and tighten when it is closed



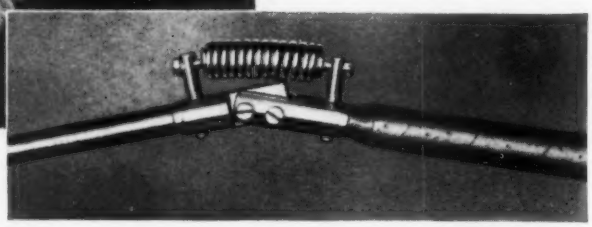


Rear view of drawer, at left, shows how the sliding partition operates

Jointed Golf Club Teaches Correct Swing

Golfer practicing with the jointed club. If he doesn't execute the swing properly, the club bends as illustrated at the right

TO CORRECT the faults of novices at golf, a Boston, Mass., professional has devised a club with a spring-hinged joint near the grip. If the user swings it correctly, it behaves as any golf club should, but a false move throws it out of joint, as illustrated in the close-up view below, completely spoiling the stroke and making it necessary to repeat the play. In trying to avoid this, the learner is forced to adopt the proper stroke.



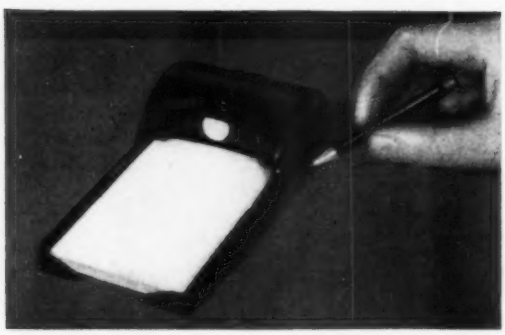
Hair is "in the bag" when cut with this vacuum clipper

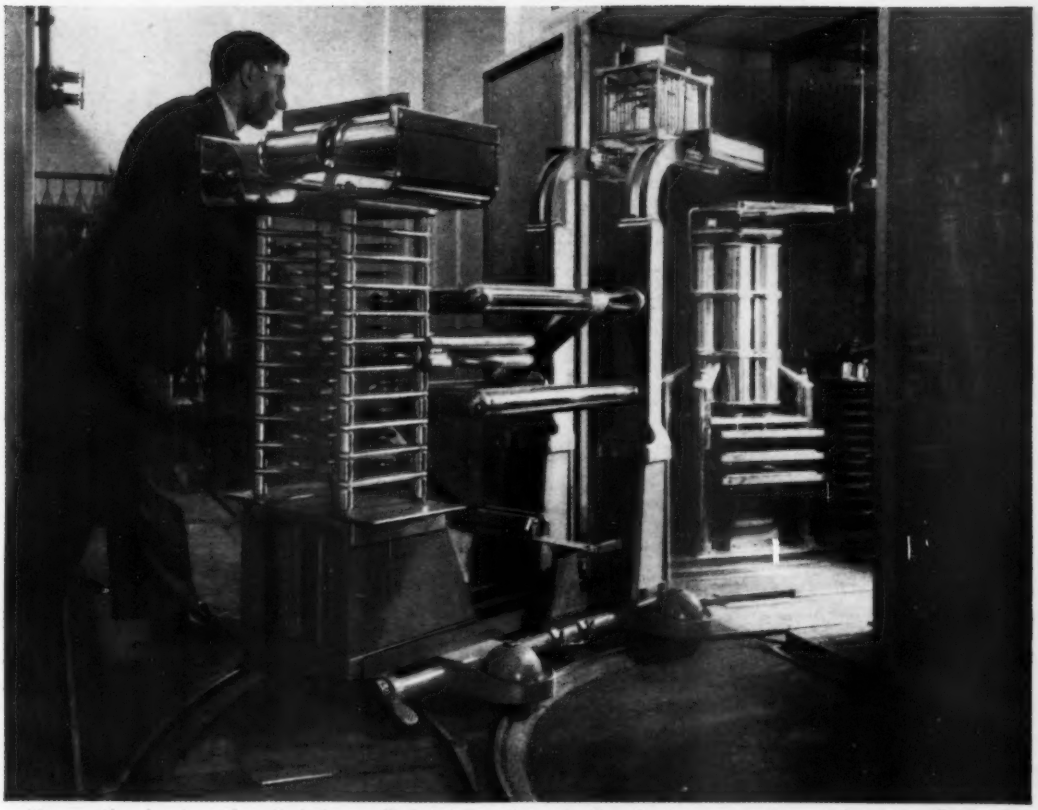
Clipper Sucks Up Hair

HAIR doesn't go on the floor when it is clipped with the new electric appliance illustrated at the left. Instead, it's in the bag. A resourceful inventor combined a vacuum-cleaner attachment with the clipper to produce this tidy result.

Illuminated Memo Pad

REMOVING the pencil of a new memo pad, as shown below, automatically turns on an electric lamp that illuminates the sheet. Handy on a night table or near a telephone, the device uses a standard, easily replaceable battery.





Mammoth plug-in-coil unit being rolled into position in the short-wave station at Daventry, England

Big Plug-In Coils Used by Short-Wave Station

JUST as you substitute one tuning coil for another in your homemade short-wave receiver, the British Broadcasting Corporation's short-wave station at Daventry, England, interchanges the world's biggest plug-in-coil units. So large that they must roll upon tracks, they enable the station to operate upon any of four wave lengths. To shift to a different wave band, the unit in use is trundled away and another takes its place.

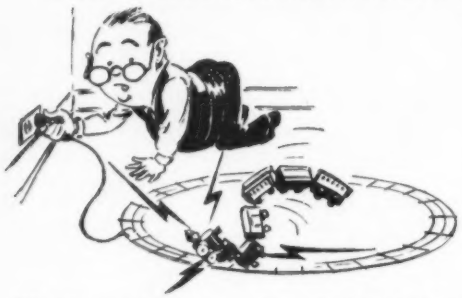
Mirror Gives Worm's-Eye View of Car Chassis

WITH the aid of a new mirror on a telescoping handle, a car owner can look on in comfort while a garage mechanic crawls beneath the machine and points out the condition of parts that need repairing or replacing. The device also comes in handy for inspecting fittings behind the instrument panel, and at other places in a car that are difficult of access. The illustration shows the new aid with its handle extended for use.

With this device a car owner can see under his auto

POPULAR SCIENCE *Question Bee*

Are you posted on the language of science and mechanics? Try to pick out the correct statement in each of the paragraphs below. Note your choices and compare them with the list on page 244



1 If you want to run a toy electric train on house current, you will need a transformer or reducer to decrease the *(a)* voltage *(b)* amperage *(c)* polarity *(d)* electrolysis.

2 Some snakes lay eggs, while others are *(a)* ambidextrous *(b)* ephemeral *(c)* viviparous *(d)* orthopedic *(e)* bivalent.

3 A ring-shaped island of coral is called *(a)* a tundra *(b)* a fiord *(c)* an atoll *(d)* a steppe *(e)* a pampa *(f)* an oasis.

4 The focusing screen of a camera is made of *(a)* wire netting *(b)* yellow-tinted gelatin *(c)* metalized cloth *(d)* ground glass.

5 Radio reception is markedly affected by *(a)* sun spots *(b)* rainbows *(c)* meteoric showers *(d)* ether drift.

6 The calendar that we now use is called the *(a)* Gothic *(b)* Mayan *(c)* Gregorian *(d)* Confucian.

7 Thoroughly mix alcohol and water, and you will have *(a)* an emulsion *(b)* a solution *(c)* a suspension *(d)* a conglomerate.

8 The Hudson type is a kind of *(a)* arch bridge *(b)* pneumonia *(c)* locomotive *(d)* machine gun *(e)* Anglo-Saxon.

9 An electrical connection to an object like a water pipe or automobile frame is called a *(a)* shunt *(b)* ground *(c)* guy wire *(d)* power take-off.

10 To invoke rain, the Hopi Indians perform their celebrated *(a)* war dance *(b)* tap dance *(c)* snake dance *(d)* square dance *(e)* fan dance.

11 What depends upon the number of threads to the inch is called a screw's *(a)* yaw *(b)* rake *(c)* pitch *(d)* caliber.

12 Acidity of a solution may be measured by *(a)* titration *(b)* sublimation *(c)* acidosis *(d)* necromancy.

13 A widely used style of raised printing for the blind is known as *(a)* Gregg *(b)* Braille *(c)* Spencerian *(d)* Caslon bold.

14 "F/6.3" might be the rating for *(a)* the magnitude of a star *(b)* the size of a twist drill *(c)* the speed of a camera lens.

15 The odd behavior of a gyroscope in tipping fore-and-aft, when its mounting is tilted sideward, is called *(a)* precession *(b)* progression *(c)* recession *(d)* secession.

16 The way was paved for important chemical discoveries by arranging all the known chemical elements according to *(a)* Bode's law *(b)* Mendelejeff's periodic system *(c)* Robert's Rules of Order.

17 A spectroscopic binary is *(a)* a pair of colors like blue and yellow *(b)* a double star *(c)* a binocular spectroscope.

18 Molten rock within the earth goes by the name of *(a)* gangue *(b)* magma *(c)* spelter *(d)* grout *(e)* sludge.

19 Theodolites are *(a)* stony meteorites *(b)* students of theology *(c)* instruments such as surveyors use for measuring angles.

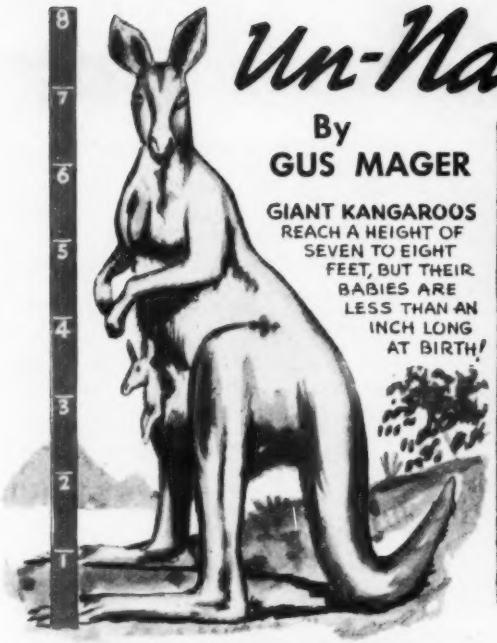
20 A numismatist is interested in things like *(a)* card tricks *(b)* the new Jefferson nickel *(c)* tide tables *(d)* the population of Guatemala.

Now It's YOUR Turn—

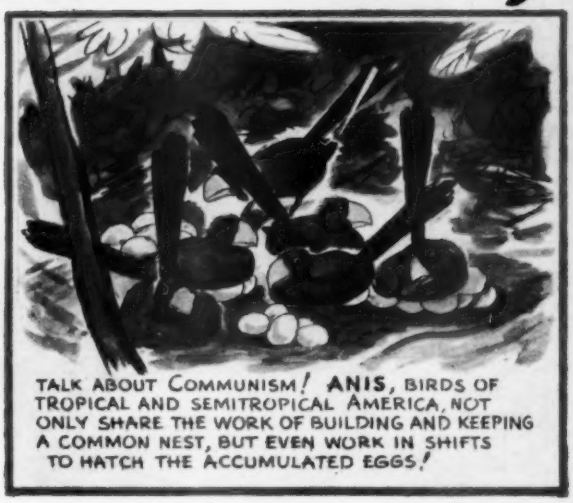
WOULD you like to make money by submitting interesting, entertaining questions for this page? We will pay $1 for each one accepted for use. No entries will be returned. Address the Question Bee Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York City.

Un-Natural History

By
GUS MAGER

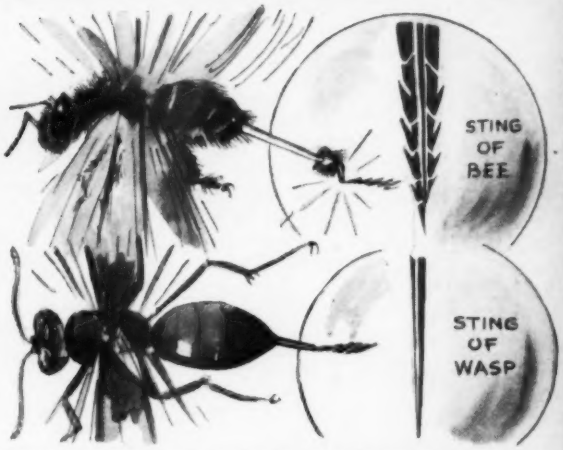


GIANT KANGAROOS REACH A HEIGHT OF SEVEN TO EIGHT FEET, BUT THEIR BABIES ARE LESS THAN AN INCH LONG AT BIRTH!



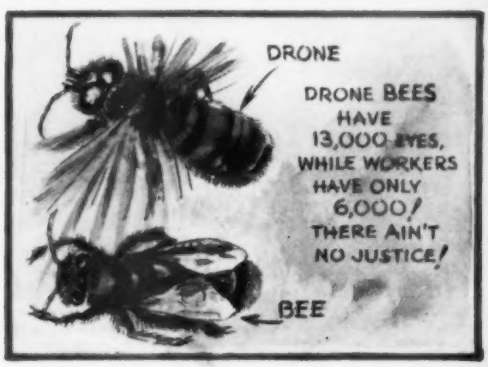
TALK ABOUT COMMUNISM! **ANIS**, BIRDS OF TROPICAL AND SEMITROPICAL AMERICA, NOT ONLY SHARE THE WORK OF BUILDING AND KEEPING A COMMON NEST, BUT EVEN WORK IN SHIFTS TO HATCH THE ACCUMULATED EGGS!

RABBITS NEVER CLOSE THEIR EYES! BUT FOR THIS EVERLASTING WAKEFULNESS, THE TIMID AND DEFENSELESS CREATURES COULD NOT SURVIVE!



BECAUSE ITS STING IS BARBED, THE **HONEYBEE** CAN ONLY STING ONCE, LOSING ITS STING AND ITS LIFE! BUT THE STINGS OF THE **HORNET, WASP,** AND **BUMBLEBEE** ARE SMOOTH LIKE NEEDLES, SO THAT THEY CAN BE USED OVER AND OVER AGAIN!

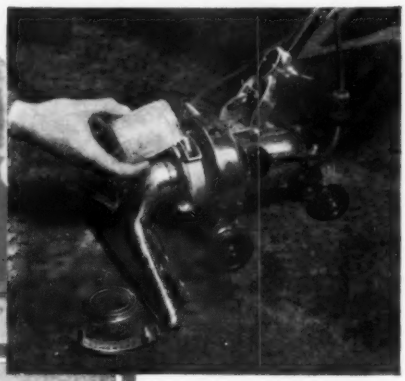
IN SPITE OF HIS SINISTER-LOOKING BRIDGEWORK, THE **PALLARA** IS A HARMLESS FISH. BUT THE INNOCENT-APPEARING **CARIBE**, WHICH INHABITS THE SAME SOUTH AMERICAN WATERS, OFTEN ATTACKS MEN AND ANIMALS



DRONE BEES HAVE 13,000 EYES, WHILE WORKERS HAVE ONLY 6,000! THERE AIN'T NO JUSTICE!

New Conveniences

LUMINOUS BEVERAGE FOUNTAIN. For serving beverages at parties, the chromium-plated fountain at the left has a motor-operated pump. Colored lights produce a novel luminous effect



SIPHON HOLDS ICE CUBES

Ready-iced carbonated water for beverages is made possible by the new soda siphon illustrated at the right, which has an opening large enough to admit even the largest of ice cubes

KILLS BACTERIA

A chemical preparation placed in a special recess in a new vacuum cleaner kills bacteria in the dust picked up

NONSKID RUG POWDER. Rugs are held in place by a new powder which is sprinkled on their under surfaces. Large rugs are treated only at edges

WALL NUTCRACKER. When a nut is placed between the self-adjusting jaws of this novel kitchen accessory, pressure on the lever removes the shell without crushing the kernel

for Homemakers

TRANSPARENT APRON
With the apron shown at the right, it is not necessary to hide a pretty dress while preparing and serving party food and drinks

TABLE BROILER
Broiling, frying, and baking can all be done on the dinner table in this electric cooking unit. The heating element can be put above or below the combination plate and griddle

PROTECTOR FOR TABLE
Slipped over a table edge, as shown at the left, a U-shaped rubber guard prevents marring by the clamps of kitchen tools

CHAIRS BECOME BEDS
Serving in the daytime as a pair of lounge chairs with a built-in table and lamp, this handy unit makes up at night into comfortable twin beds, as illustrated below

GUS SAYS ...

Don't Trust Your Ears

By MARTIN BUNN

Gus drove the car into the shop, raised the hood, and went to work in his methodical and deceivingly leisurely fashion

IT WAS a late-winter evening during one of those warm spells that give a false hope of an early spring—one of those evenings when you like to talk about fishing, automobile trips, and summer vacations. So the little group of Gus Wilson's friends and customers who like to congregate in the Model Garage were just "discussing"—going from one thing to another. By ten o'clock, they had worked around to the subject of the squeaks, squeals, knocks, and other noises which are the occasional by-products of driving an automobile.

Henry Miller, who is strictly a Sunday driver, was holding the floor with a detailed and vivid description of the various weird sounds which had been produced by his car in the course of a trip up to New Haven to visit his wife's family, a description that failed to astonish his hearers, who always are wondering how Henry's bus holds together at all under the punishment that Mrs. Miller gives it. Gus Wilson only half listened while he went ahead methodically with his chore of retinning a half-dozen soldering irons of various sizes and shapes. The ailments of the Miller car, and their many harrowing symptoms, are old stuff to Gus, who hears much more than he wants to about them from the talkative Mrs. Miller.

As Miller's narrative ended, brakes squealed shrilly outside the shop, and a few moments later a small, worried-looking man came in. Looking from one to another of the group of talkers, he asked mildly: "Boss in?"

Grinning, Gus Wilson glanced at his partner, Joe Clark, and then turned back to the visitor. "I'm one of them," he admitted. "The one who does all the real work!"

The little man smiled nervously and backed away a couple of steps. "I'd like to speak to you," he said.

Gus went to the door with him, and glancing out saw an ancient and battered sedan. "What's the trouble?" he asked.

"I came from Pittsburgh today," the little man told him. "Got the wife and two young kids in the back seat. Going on to Boston tonight—I've got to get there quick because there's a job waiting for me there, and I *do* need a job.

"Well, when I got near Philadelphia this afternoon, I began to hear noises in the old bus. That wasn't anything new, of course—she's got over eighty thousand on her, and she always did rattle. But this was the kind of a noise that makes a fellow nervous—a sort of a low, heavy knock whenever we pulled up a steep hill.

"I got worried, so I went into a garage and told the mechanic about it. He put on the emergency brake, and then raced the motor and let in the clutch until she stalled. Then he said all the main bearings were gone. Wanted twenty dollars to replace them, and said it would take two days. That meant staying over in Phillie, of course, and I just didn't have the money to do it.

"I didn't know *what* to do. While I was thinking about it, I got to talking to a man who said he knew all about cars. He looked mine over and said the mechanic was right—main bearings were gone. But he said that if I filled her up with extra-heavy oil, and didn't drive over twenty, maybe I'd make it. So I took the chance.

"She knocked plenty at twenty, whenever we hit a hill. A little way out of Phillie, while we were going up a steep grade in a lot of traffic, a motor-cycle cop come along and started giving me the devil for jamming

everything up. I couldn't afford to have any trouble with him, so I had to step on her. Funny thing—she didn't knock nearly as bad at thirty-five as she did at twenty, and when I got her up to forty she didn't knock at all hardly—even on the hills.

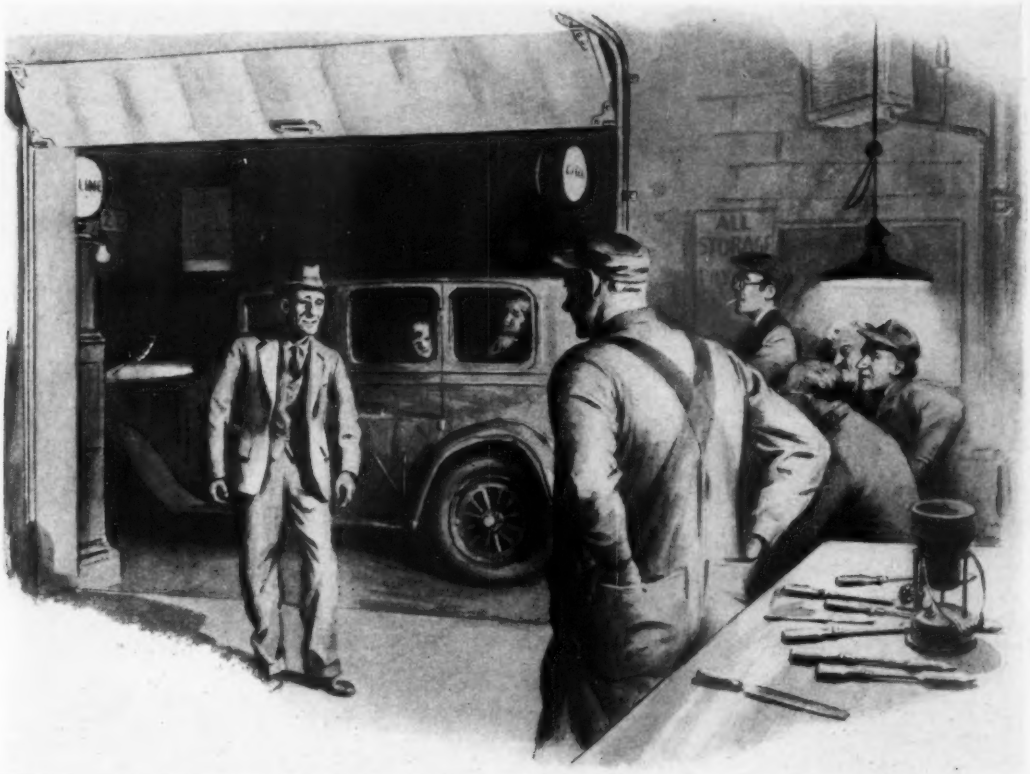
"So we came along pretty good, and got through New York City without having any trouble. But I had to slow down coming up a hill down the road a piece, and she hammered so hard I thought the motor was coming apart. So, when I saw your sign, I thought I'd better stop in and see if anyone in here would tell me what I oughta do. I can't pay for any big repair job, so if the old bus ain't going to make it to Boston the way she is, I guess I'll have to sell her for junk, and me and the family'll have to go on by bus. I got to be there tomorrow morning, sure."

Joe Clark sometimes accuses his partner of being a soft touch for anyone with a hard-luck tale. But Gus Wilson has been around—he knows as much about people as he does about cars, and he doesn't make many mistakes about either. Now, the little man's anxious, worried face, and the tired woman and children on the back seat of the worn-out old sedan, told him all he needed to know.

"Sure," he said. "I'll be glad to take a look. I've traveled myself without much in my pocket to do it on. It might be that I could figure out some way of keeping you rolling that won't cost you anything much."

He drove the car into the shop, raised its hood, and went to work in his methodical and deceivingly leisurely fashion. Leaving the engine running, he pressed the clutch pedal down with his hand. "Sometimes you can feel a really bad bearing knock that way," he explained. He speeded up the engine suddenly, and listened to it for several seconds. "Yes, there's a knock, all right—but I doubt very much if it's a bearing knock," he said. "A loose bearing makes a noise like a heavy block of wood falling some distance and striking the ground—a dull sort of thud. The knock in your engine—if that is where it is—is low and heavy, as you said, but I'm pretty certain that it isn't caused by a bad bearing, even if it did sound enough like it to fool that repairman down in Philadelphia. Well, now let's see. I guess using a sounding rod will be the quickest way of locating the trouble."

He went over to his workbench, and came



A small worried-looking man came in. "Boss here?" he asked mildly. Grinning, Gus Wilson glanced at Joe Clark and then turned back to his visitor. "I'm one of them," he admitted. "The one who does all the work."

back with a two-foot-long steel rod. Placing his thumb over its upper end, and his ear against his thumb, he began holding the lower end of the rod against various parts of the engine and running gear, listening intently.

"Here we are," he said after a couple of minutes. "It's in the generator." He leaned over and examined the generator, and then laughed reassuringly. "See what's wrong?" he asked the little man. "Your generator is mounted on a pivoted bracket, so that the fan-belt tension can be adjusted. All that's the matter is that it's worked loose, and knocks against the engine block—mostly when the engine shakes on a low-speed, uphill pull. I'll just tighten up that nut—and you can get on your way!"

"Thanks—thanks, Mister," the little man said in a relieved voice. "But how about your time—how much do I owe you?"

"You don't owe me anything," Gus assured him. "I've got to be careful about this new-fangled hours-of-labor law. I worked eight hours today, and I'd be breaking the law if I worked any more this evening. I don't want to get Secretary Perkins after me, so anything that I do after regular hours is just for the fun of it. . . . . Oh, that's all right—that's all right! Good luck to you on the new job!"

After the old sedan had clattered off up the road, Gus rejoined his fellow members of the Model Garage Debating Society. "What was the trouble with that fellow's car?" they wanted to know. Gus told them. "Another example of believing too many of the things you hear," he finished.

"I'm always hearing mysterious noises in my car, especially when I have to drive alone at night," young Jack Simpson remarked. "And usually they don't mean anything much, when I get Gus to track them down for me. One night, one of those funny noises almost drove me nuts. It sounded as if a tin pie pan on a string was banging along the road under the car, and it wasn't anything more important than that little metal plate over the storage battery having worked loose. And another night I heard a terrible thumping noise whenever the car went over a bump. I was dead sure I had a cracked universal—but it was just a piece of stone that had got itself jammed between the universal casing and the frame of the car."

Gus Wilson

Even a car can have too much of a good thing. Overloading a differential with lubricant doesn't do any good, and it can do a mess of harm. Nine times out of ten, it's forced through the rear axle onto the brakes, and it spoils the linings.

Ed Zacharias, the weather-beaten old R.F.D. carrier, bore down hard on his cud of eating tobacco and then looped a perfect ringer into the waste box under the workbench. "Shucks!" he said. "That wasn't nothing! Why, one day I was driving along in my old car, way out in the country, when all of a sudden there was a shrill, yowlin' noise that sounded like a tomcat cussin' you when you've stepped on his tail. Soon as I threw out the clutch, the yowlin' stopped. 'Dry clutch bearin', by jingo!' I says to myself, so I nursed the old gal along until I come to a garage, and then I had the clutch greased. After that I drove a couple of miles without any trouble—and then that yowlin' started in again. So I stopped at another garage, and the feller there said that my clutch was slippin'. He worked on it for a half an hour, and said it was O. K. I drove off—and then pretty soon the same blamed thing happens again. So I come over here to Gus. He listens a minute, and says: 'Slipping clutch, my eyebrow!' And what do you think was wrong? Nothin' but my fan belt so loose that it was slipping part of the time, and the metal of the motor was carryin' the sound around so it sounded like it was in the clutch!"

"I suppose you have a lot of people coming in here with stories about hearing queer noises in their cars, don't you, Gus?" George Knowles asked.

"Sure do," Gus assented. "And sometimes the queer noises they hear are the result of queerer goings-on in their cars. A couple of months ago, a man came in with a bad knock in his engine. After quite a while I located the cause of his grief—some one had been careless enough to drop a lock washer into his carburetor!"

"But some of the noises that a car makes are sure-fire symptoms that something is wrong, aren't they, Gus?" Knowles asked.

"No engine noise," Gus replied, "is absolute proof of a particular trouble—it's just a clew. When you go hunting for the trouble, the first thing to make certain of is that the noise really is being made by an engine part. No one ever did his car any good by doing the wrong repair job on it!"

THE HOME WORKSHOP

In This Issue.. BIRD-HOUSE BUILDING • YACHT MODEL • HOW TO ETCH • TWIN-BED RADIO • SHOP HINTS • NEW PHOTO IDEAS

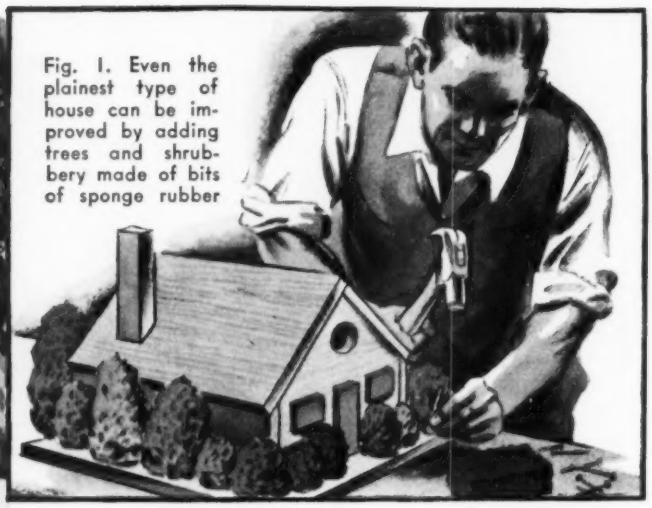


Fig. 1. Even the plainest type of house can be improved by adding trees and shrubbery made of bits of sponge rubber

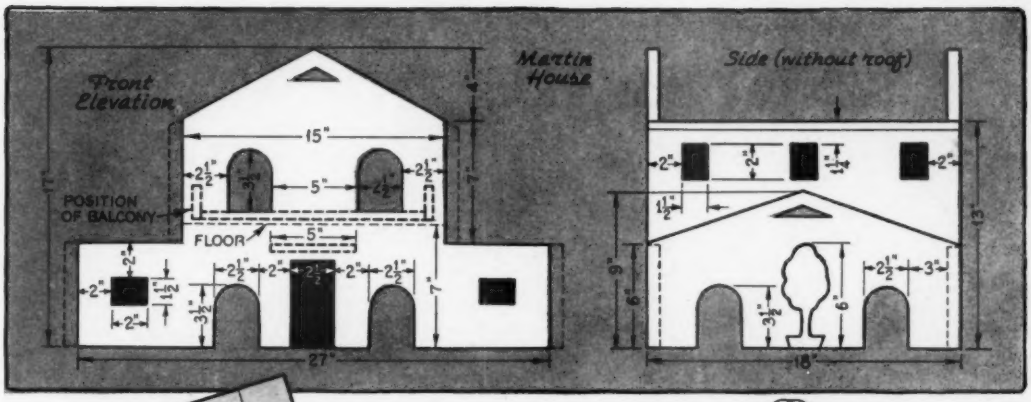
NEW WAYS TO BEAUTIFY

Bird Houses

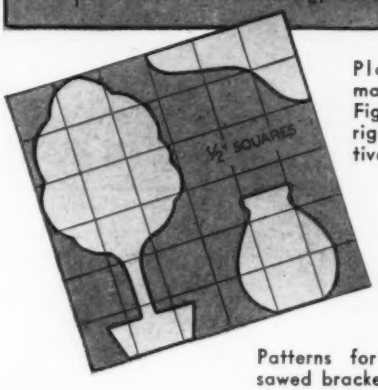
ANY ordinary bird house, no matter how homely in design, may be transformed into a thing of beauty by landscaping it with fragments torn from green and brown rubber sponges as in Fig. 1. The floor is extended to project ½" or more on all four sides, and the bits of sponge are fastened on it by slender box nails driven through each in several directions. The nails are driven into the wood only far enough so the heads will be concealed; they then serve as shafts to support the sponges. Thin, dark-colored wood is used for the

Fig. 2. This quaint little bluebird house suggests a fairy tale

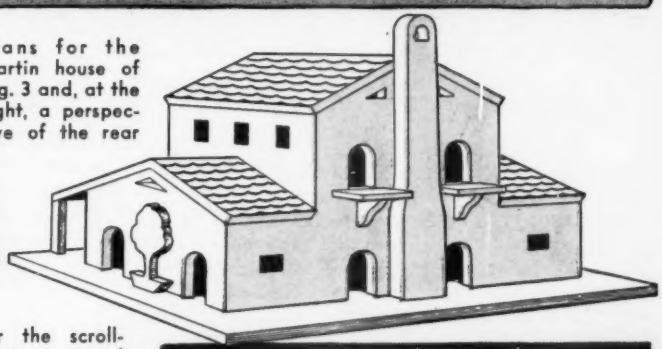
Fig. 3 (right). Twelve-room house for martins

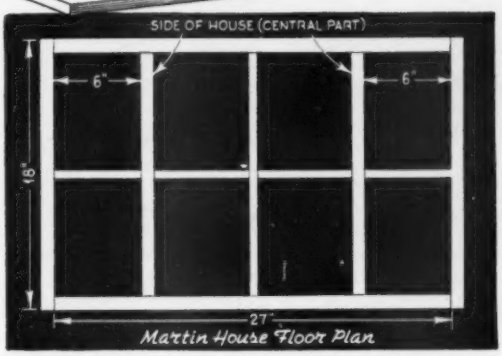


Plans for the martin house of Fig. 3 and, at the right, a perspective of the rear



Patterns for the scroll-sawed brackets, urns, and shrubs used as ornaments





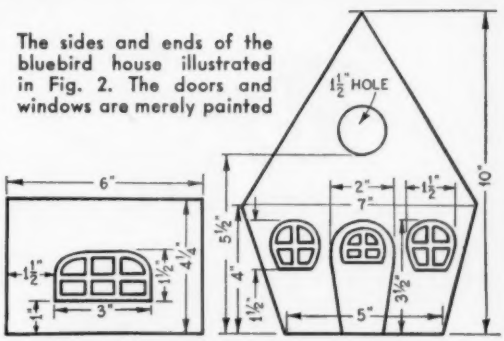
imitation doors and windows of the house.

Painted in brown and reddish tones, the bluebird house illustrated in Fig. 2 seems a natural part of a garden or woodland setting. It is constructed of ½" wood, with heavier blocks of wood for the base. One side of the roof is hinged so that old nest may be removed. The house may be placed 6′ or 7′ from the ground on a slender post under a tree.

Don't forget that a painted bird house should be set out long before you expect the birds to use it so that it will become weathered. Purple martins, however, seem to have no objection to painted houses and will gladly accept the colorful Spanish residence shown in Fig. 3. Use 1" white pine (its dressed thickness, of course, will be less—usually ¾" or ⅞") for the walls and ½" stock for the partitions and roof. Triangular openings in the gables and holes bored under the perches provide ventilation. Cleats that may be easily removed at cleaning time are tacked as thresholds just inside the door openings to protect the nests.

The martin house should be supported firm-

The sides and ends of the bluebird house illustrated in Fig. 2. The doors and windows are merely painted



HAZEL F. SHOWALTER SKETCHES FIVE DESIGNS THAT ARE ATTRACTIVE YET SIMPLE TO BUILD

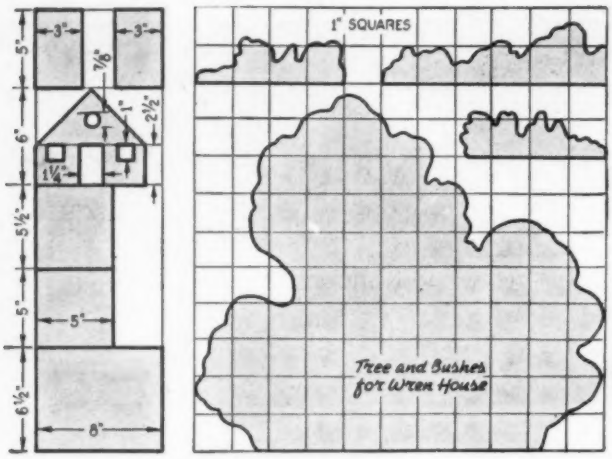


Fig. 4. Wren house decorated with flat tree forms and bushes sawed from ½" wood. The house may be cut from a board as shown at left

ly on a substantial platform at the top of a pole 15′ or 20′ high. A good way to arrange for lowering the house for its annual cleaning is to set two short posts in the ground, preferably with concrete, and fasten the long post between them with two bolts. When one bolt is removed, the long post will tip, lowering the house to the ground.

Another method of decorating a small wren house is to cut flat tree forms and bushes from ½" white pine and fasten them as in Fig. 4. The house is left unfinished, but the tree and bushes are given a coat of green paint.

Wrens enjoy a two-room house like that in Fig. 5, with a tight partition in the middle and an opening at each end. The awkward shape of the two-room bird house is overcome by letting the floor extend 1" along each long side. A little fence is then added.

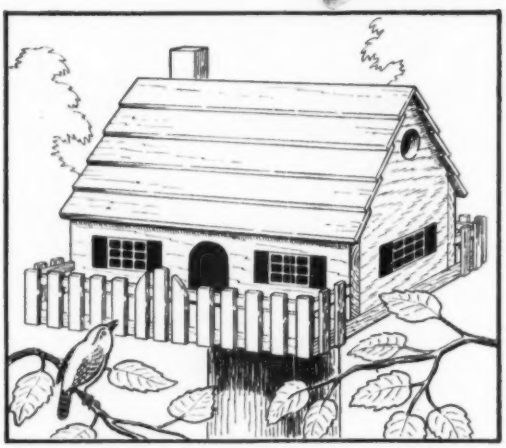
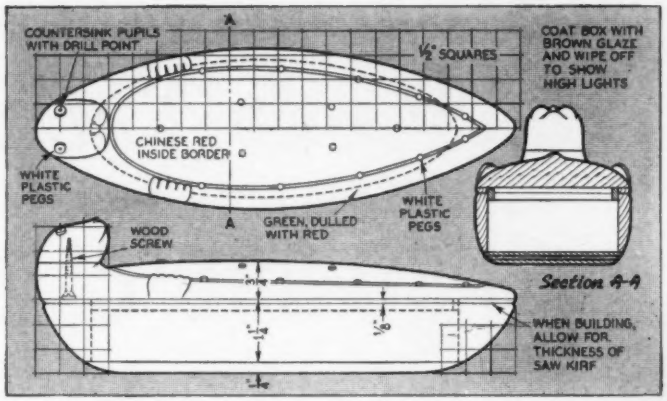


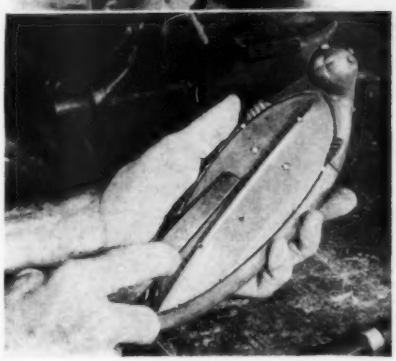
Fig. 5. A two-room house may be improved by letting the floor extend front and back and adding a fence

Shadow Lines Used in Testing Curves of Ship-Model Hull

Using an electric light to find imperfections

IN SHAPING the hull of a ship model, a smooth curve from stem to stern can be obtained more easily if tests are made by holding the hull on its side beneath an electric light in such a way that the edge of the shadow may be observed. If the shadow shows an uneven curve or there is any irregularity, the hull requires additional shaping. By rolling it slightly, the hull may be tested from bulwarks to keel. Then, to insure both sides being alike, hold the hull keel up, with one end pointing directly towards the light, and slowly tilt the model up and down. The shadows will show if both contours are alike.—CURTIS WARD.


COUNTERSINK PUPILS WITH DRILL POINT
½" SQUARES
COAT BOX WITH BROWN GLAZE AND WIPE OFF TO SHOW HIGH LIGHTS
CHINESE RED INSIDE BORDER
WHITE PLASTIC PEGS
GREEN, DULLED WITH RED
WHITE PLASTIC PEGS
WOOD SCREW
Section A-A
WHEN BUILDING, ALLOW FOR THICKNESS OF SAW KIRF



Miniature Seal Lying on Back Forms Eskimo Trinket Box

THIS unique trinket box, copied from an Eskimo original, is carved to represent a seal lying on its back. Band-saw the body, glue on the bottom, and shape on a sanding disk. Rough out the top, leaving square stock at the edges for carving the flippers. Incise the border line with a veining tool. To carve the head, first jig-saw the top outline, brad the waste pieces back in place, and cut the profile. Glue the top to the box.

Cut off the lid on the circular saw, and flange it with a thin strip of wood glued around the inside and wedged temporarily with small blocks. After painting, drive ¼" pegs made from a knitting needle into eye holes and ⅛" pegs into the box, filing them down to a projection of about 1/32". Line the box with leather. Paint the box as indicated. Garishness is prevented by a coat of brown glaze wiped to show high lights.—E. M. LOVE.

PULL-CHAIN SOCKETS [*ELECTRICAL*]

IN REPLACING a defective pull-chain socket, it is important to connect the wires correctly. Most modern systems are polarized so the fixtures are grounded through their connection with the outlet box and the metal armor of the BX cable. One of the fixture wires is usually plain, and the other has tracer marks. The latter should be the grounded wire. Connect it to the silver-colored socket screw, and the plain wire to the brass one. If in doubt, test the wires with a test lamp. The wire giving no light to the metal of the fixture is the grounded wire. In a body-type fixture such as shown, drop the bottom part down to obtain some slack wire. Be sure to shut off the current before attempting any repairs.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

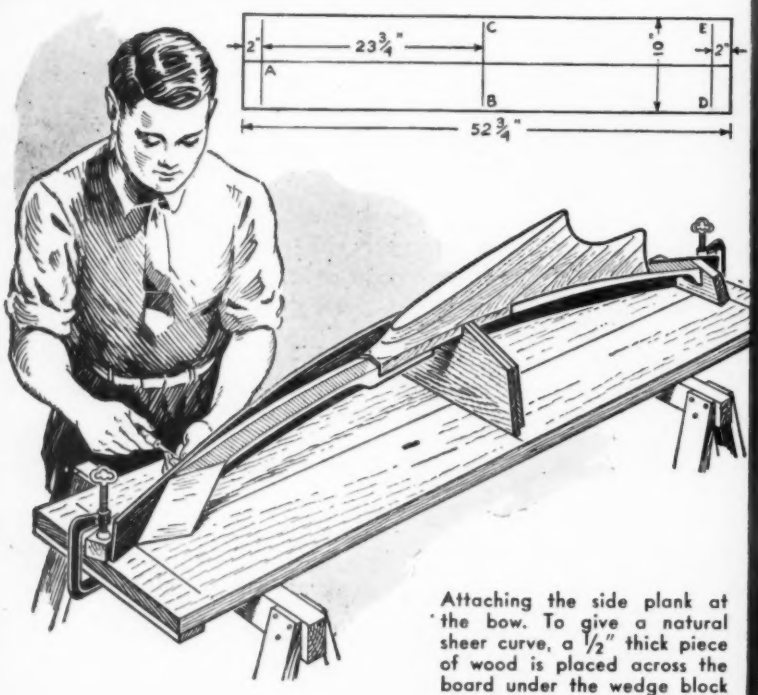
Unlike most model yachts, this one does not have a hollowed-out hull. Built-up construction is used instead

SIMPLIFIED V-BOTTOM Model Yacht FOR RACING IN THE '50-800' Class

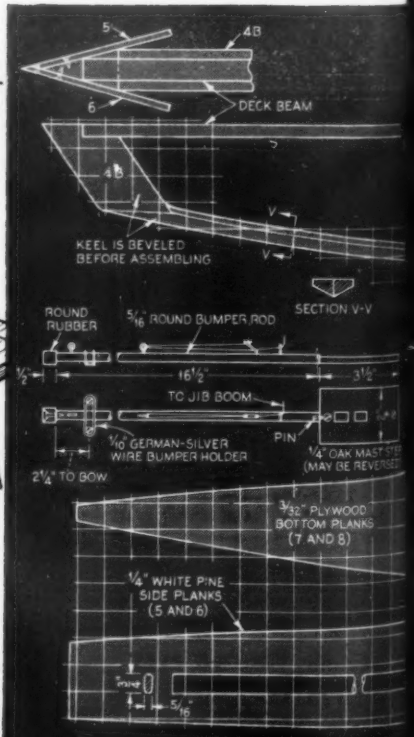
AMONG model yachts, the Marblehead class is one of the most popular. These boats are 50" long and carry 800 square inches of sail. They usually take considerable time to build, but the writer has designed a V-bottom model that conforms to all regulations yet is much easier to construct than the hollowed-out, round-bottom type. The hull is assembled in a novel manner similar to the 29" V-bottom sloop previously described (see P.S.M., May '38, p. 74)—a distinct advantage for the inexperienced model builder.

To build this yacht first obtain a work board ¾" by 10" by 52¾". Draw a center line and mark off perpendicular lines 2" from each end and 25¾" from the left end as shown below, labeling the points as indicated.

Glue two pieces of ¾" white pine face to face for keel sections *4B* and *4C* and cut to



Attaching the side plank at the bow. To give a natural sheer curve, a ½" thick piece of wood is placed across the board under the wedge block



shape. Build up strips of wood 1½" wide and ¾" high for section *4A*, using waterproof glue. (This is done to prevent the keel from warping.) Taper *4A* so that it has the same shape at the bottom as the top of the lead keel. Towards the stern, the piece tapers to a thickness of ⅛" and is about ¼" thick at the edge of the circular part. Sections of the keel at various points are given to aid you in shaping it. Drill a screw hole in *4C* at *F;* then fasten the keel parts together with screws and glue.

Cut stern block *3* from ¾" white pine; mold block *1* and wedge block *2* from ¼" pine.

Join mold block and wedge block with two screws so keel notches are aligned, and set keel into the notches. Place on work board so bow end of keel is at *A* and stern side of mold block at line *BC*. Apply glue to keel at *A* and *F*, to mold block at *BC*, and to stern block at *DE;* then allow to set overnight.

Before cutting side planks *5* and *6*, make cardboard templates to determine the exact shape. Then cut the planks, clamping them together to make certain they are alike. Secure plank *5* at *D* with two ¾" No. 6 screws, bend around wedge block, and fasten to stem part of keel with two similar screws, one near deck and the other near chine. A ½" thick strip may be laid on the work board alongside the mold block to give the necessary sheer curve. At *A* saw off plank *5* in a plane with opposite side of keel. Next fasten plank *6* in place. File edges of *5* and *6* to make a tight joint before fastening together at bow with ⅝" No. 4 screws. Be careful to drill the correct size holes before inserting screws, or planks may split. Fasten stern block to keel at *F* with a long screw as indicated, and attach planks to wedge block with glue and screws.

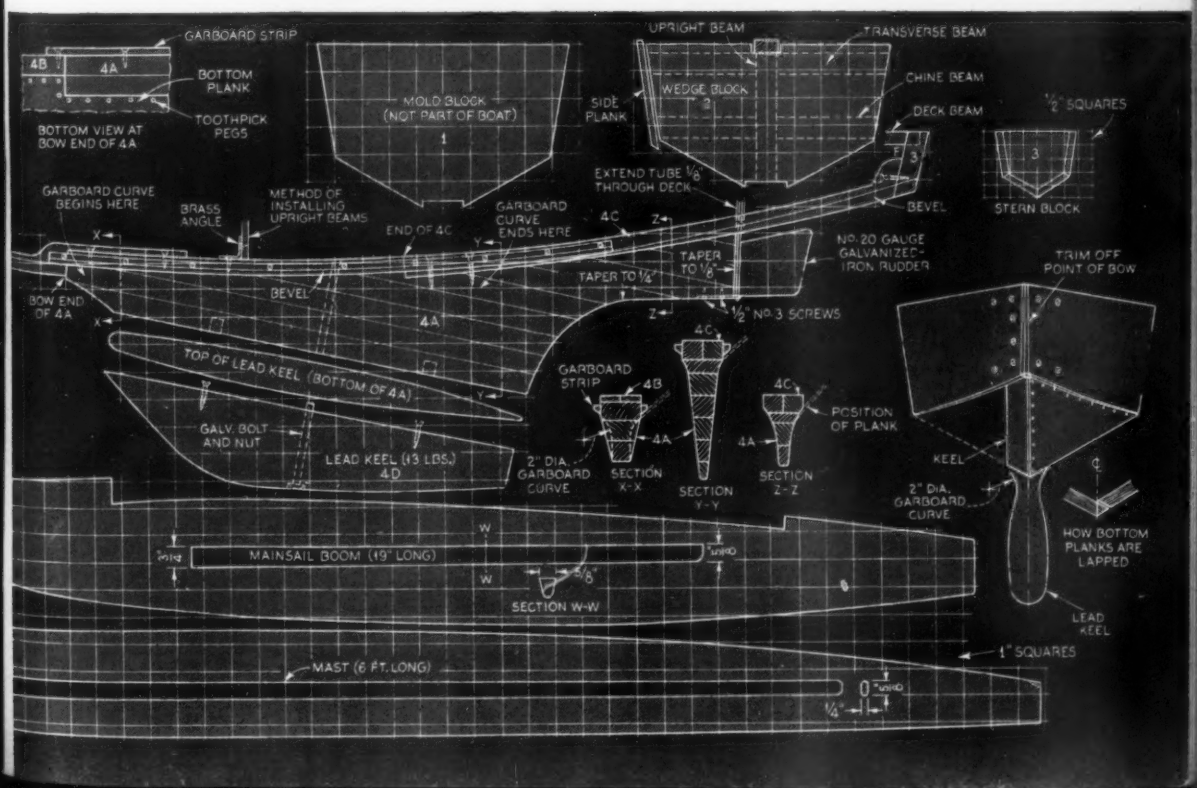
Now remove frame from work board by taking out screws holding wedge block to mold block and sawing away the glued stem piece at *A* and stern block at *DE* with a thin hack-saw blade. The mold block is discarded —it is not a part of the finished model.

Drill a ⅛" hole for the rudder stock vertical to the deck as indicated, and a 3/16" hole to a depth of 3/16" on inside of keel for the tube. Fit deck beam into notches in stem piece, wedge block, and stern block, and fasten with screws. Drill a 3/16" hole in deck beam in line with hole on inside of keel. Fit rudder-stock tube into place.

Cut the transverse beams, chine beams, and uprights from ¼" white pine. Their location is shown by dotted lines in the drawing of the wedge block and in the plan view of top. Glue them into place and fasten beams to side planks by driving toothpicks from the outside. The uprights are attached to the keel by means of small brass angles. Before drilling holes through deck beam and transverse beams for screws, be sure that outside edges of side planks are equidistant from center line of deck beam.

Apply plastic composition wood around the rudder-stock tube where it is set into the keel to insure

By BERNARD FISCHLER



LIST OF MATERIALS

For	Dimensions	Material
Work board and keel	¾"x10"x8'	White pine
Side planks	¼"x9"x52"	White pine or mahogany
Mold blocks and beams	¼"x12"x3'	White pine
Deck	3/32"x10"x50"	Waterproof birch plywood
Bottom planks	3/32"x12"x50"	Waterproof birch plywood
Garboard strips	¼"x⅜"x4'	White pine
Deck beam	½"x¾"x4'	Mahogany
Jib boom and bumper	5/16" round x3'	Dowel
Mast	¾" round x6'	Spruce
Boom	¾" round x19"	Spruce
Mast step	¼"x2"x3½"	Oak

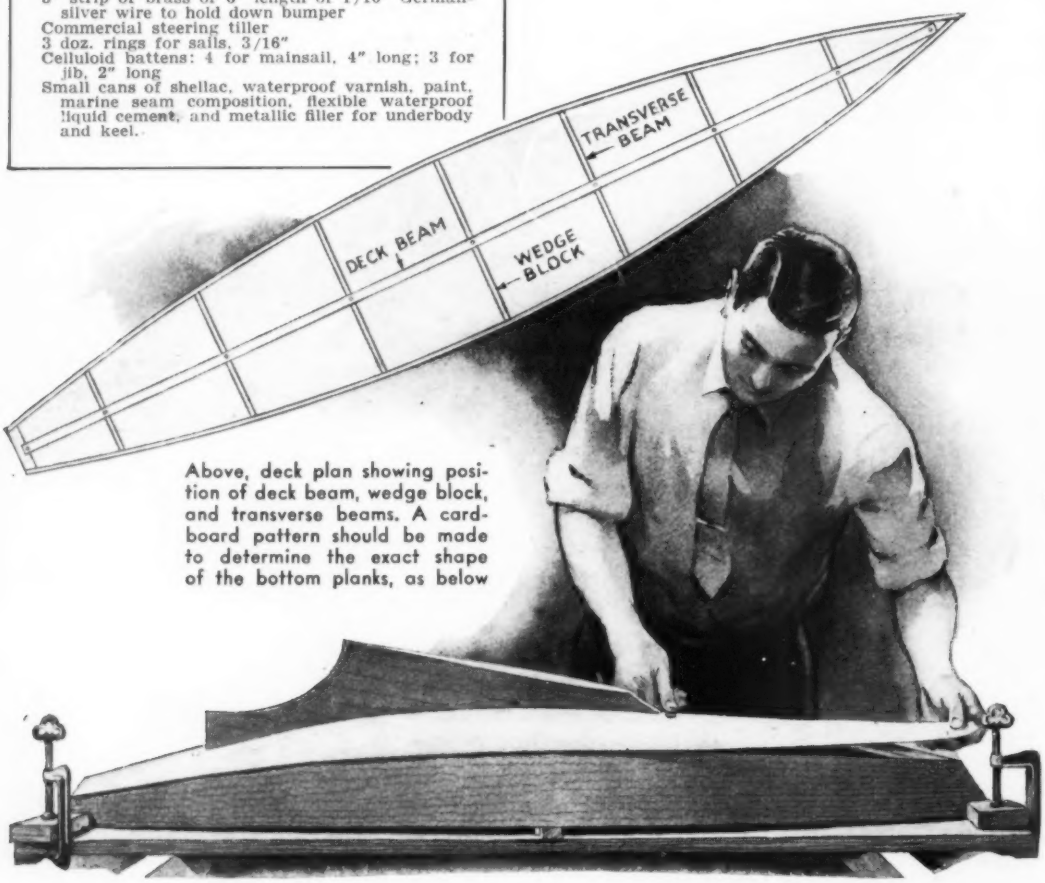
⅛" brass wire rod for rudder stock, 6" long
3/16" copper tubing for rudder-stock tube, 4" long
20-gauge galvanized iron or brass for rudder, 3" x 3"
Brass plate for rudder skeg, 1/16" x ¼" x 2"
¼" galvanized-iron bolt and nut to hold lead keel, 7" long
2 yd. balloon cloth 36" wide
2 doz. ¼" brass screw eyes
Flathead brass screws: 2 doz. ½" No. 3, 1 doz. ⅝" No. 4, 1 doz. ¾" No. 6
1 doz. toggles
1 doz. rigging hooks
6 brass angles, 1/16" thick x ½" wide x ¾" legs
15 lb. lead
3" strip of brass or 6" length of 1/10" German-silver wire to hold down bumper
Commercial steering tiller
3 doz. rings for sails, 3/16"
Celluloid battens: 4 for mainsail, 4" long; 3 for jib, 2" long
Small cans of shellac, waterproof varnish, paint, marine seam composition, flexible waterproof liquid cement, and metallic filler for underbody and keel.

against any water leaking into the hull.

Fasten the garboard strip to each side of keel with ½" No. 3 screws as indicated, after cutting off triangular projections on bottom of wedge block. Determine size of bottom planks by means of cardboard patterns; then cut the planks to shape.

Wrap a piece of coarse sandpaper around a 6" wood block. Starting at bow, with one end of the block resting on the keel, the other end on a side plank, finish the edges parallel on an even curve from bow to stern. Apply a thin layer of seam composition to edges of one side and hold a plywood bottom plank in place at bow and stern temporarily with wire. Hold a 75-watt electric bulb inside hull to see where to drill holes for toothpicks used to attach bottom plank to side plank and keel. Use an automatic hand push drill with a No. 2 drill and space holes ½" apart.

Trim toothpicks to proper length and thickness, dip in shellac, wedge into holes, and hammer in place. Attach plank to center of keel at garboard strip first. Trim pegs flush and sandpaper the whole. Cut plank flush



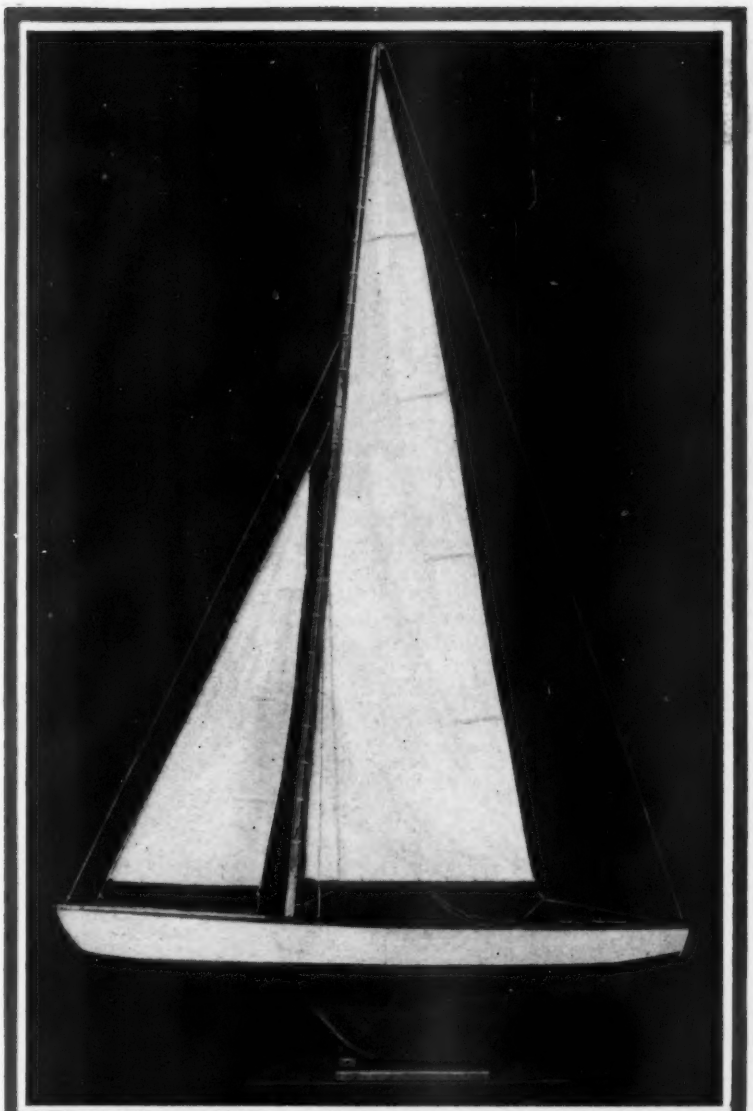
Above, deck plan showing position of deck beam, wedge block, and transverse beams. A cardboard pattern should be made to determine the exact shape of the bottom planks, as below

with side of boat and off center along keel. Fasten other plank in same way, but lap it over the first plank at keel and trim so that edge will be at center of keel as shown. Remove thin edge of overlap with a razor blade and fill with seam composition.

To obtain the garboard curve, take a round wood rasp and file out an arc of a 2″ circle between the two points indicated on side view of keel. If you intend to enter Marblehead races, this must be done carefully so that a 2″ disk will fit perfectly into the curve, which is shown in front view of hull, and in sectional view X-X. Otherwise, your model will be disqualified.

Drill hole for the bolt that holds lead keel in place. Make a wood pattern of lead keel and take to a foundry to be made or pour lead in a sand mold. The finished keel should weigh 13 lb. Attach to wood keel as shown. The two screws which fit into the wooden keel are to keep the lead from turning.

Give one coat of paint to inside of hull. Apply seam compound to side planks, stern block, and around rudder-stock tube. Attach deck on top of deck beam and side planks, sandpaper it, and give several coats of outside varnish to deck; then paint hull any color desired.



The completed model. The shape of the sails can be altered somewhat, if desired, providing the area remains less than 800 square inches

The rest of the construction should offer no difficulties if the drawings are followed. Cut the rudder from 20-gauge galvanized iron, and solder the rudder stock to it. Attach the brass plate for the rudder skeg with ½″ No. 3 screws. The author recommends using a commercial steering tiller, such as can be purchased at model supply stores, but you can devise your own if you wish.

Cut the sail cloth so that weave is at right angles to outer edge of mainsail and inner edge of jib. Be sure to allow for a ¼″ seam. Variations can be made in the sails, but the total area should not be more than 800 square inches. There are four 4″ celluloid battens on the mainsail and three 2″ battens on the jib.

Install bumper, mast step, and mast; arrange sails and rigging as indicated; and your yacht is ready to show what it can do. You may find it necessary to move the mast from one hole to the other or to reverse the mast step in order to obtain the best results.

As an easy means of lifting the model out

of the water, attach a piece of chain to the center of deck with screws 23″ and 30″ from bow. For carrying long distances, an 8″ leather strap affords a more comfortable grip.

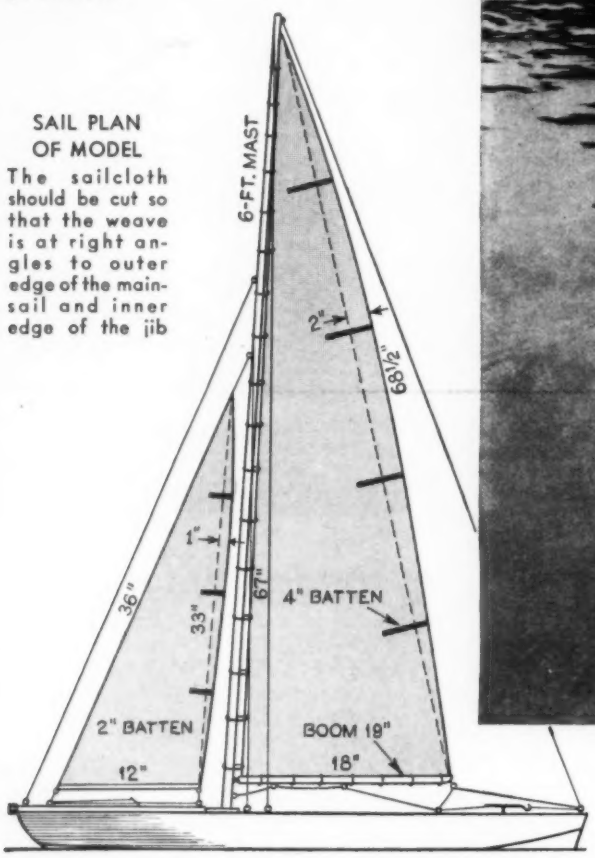
The writer has sailed his model with great success in numerous races at Central Park and Jamaica Bay, New York. If you have built your model carefully, it should perform as well, if not better.

In addition to various rules mentioned in this article, the following regulations of the Model Yacht Racing Association of America must be kept in mind if the boat is to be entered in official races:

Bumpers are not included in overall length measurement, but are limited to a ½″ overhang. Only a ¼″ variation is allowed in the 50″ overall length of the model.

The roach of the sails cannot exceed 2″. No wire or other stiffening can be put in the head of sails.

Movable keels, metal fin keels or others without hollow garboard, center boards, lee boards, bilge boards, bowsprits, and overhanging rudders are prohibited.



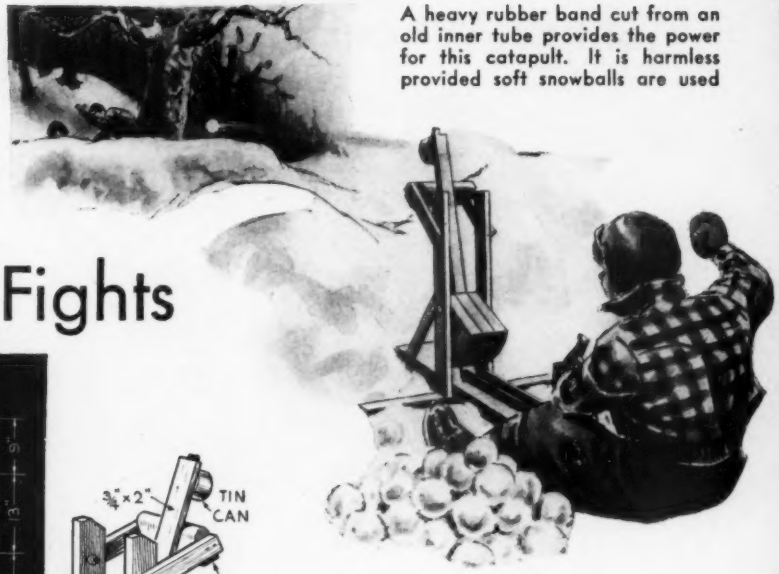
SAIL PLAN OF MODEL

The sailcloth should be cut so that the weave is at right angles to outer edge of the mainsail and inner edge of the jib

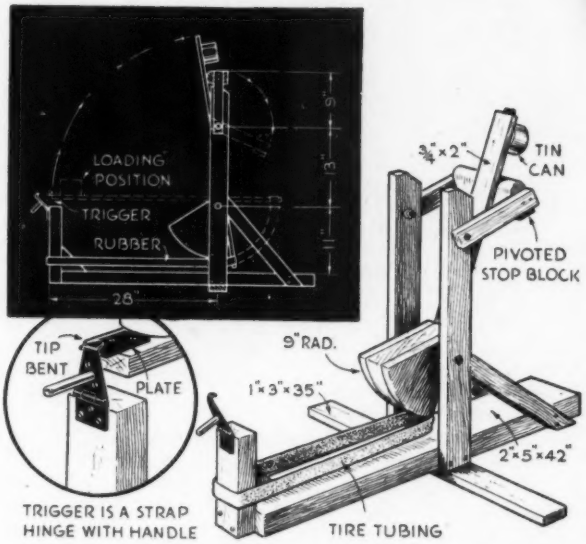
Note how the side and back stays steady the mast. Toggles are used to tighten or slacken the lines when desired. A chain handle can be seen on the deck

Catapults

ADD THRILLS TO Snowball Fights



A heavy rubber band cut from an old inner tube provides the power for this catapult. It is harmless provided soft snowballs are used



As the trigger is pressed, the arm flies up and hits the stop block, which is pivoted to prevent damage to the arm

SNOWBALL battles are much more fun when the skirmishers are supported by heavy artillery in the form of catapults. Scrap materials are used for making the type illustrated, and a rubber band cut from an old inner tube provides the power. When the trigger is pulled, the arm flies up and hits the ejector block, whereupon the snowball in the tin can is hurled forward. The ejector block, it will be noted, is pivoted so that it swings down when struck in order that no damage will be done to the arm of the catapult.

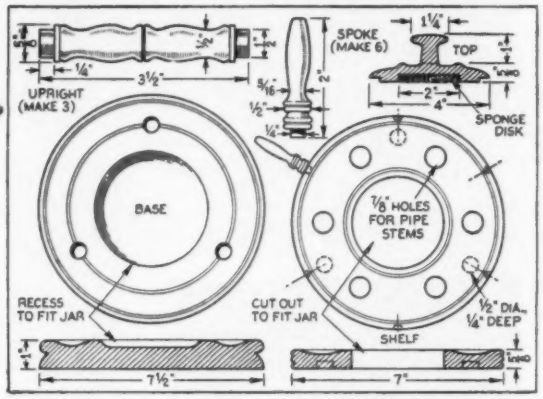
CUTTING A TAPER [*CALCULATIONS*]

Taper turning can be accomplished on the lathe by setting over the tailstock. To determine the amount the tailstock must be shifted, take one-half of the taper per foot times the length of the work in feet. Always consider the total length of the work or the distance between centers, instead of the length of the taper portion. If the taper extends the whole length, the offset will be one-half the difference between the diameters of the large and small ends.

Several standards are used in shopwork. Their *approximate* tapers follow: Morse, $\frac{5}{8}$″ per ft.; Brown & Sharpe, $\frac{1}{2}$″ per ft.; Jarno, 0.6″ per ft.; Sellers, $\frac{3}{4}$″ per ft.; Reed, 0.6″ per ft. For accurate measurements, always refer to a chart or handbook giving the exact figures.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Ship's-Wheel Pipe Rack and Humidor



An old cold-cream jar is used for the container. The cover and pipe rack are turned, preferably from walnut

BESIDES being a welcome addition to the pipe lover's den, this ship's-wheel pipe rack and humidor is a project to appeal to every lathe owner. First obtain the jar. A cold-cream jar 4¼" in height and 3½" in diameter is ideal.

Mount an 8" square of 1¼" black walnut on the lathe faceplate and turn it down to 7½". Recess the center about ⅜" to fit the bottom of the jar; then shape the rim and edge as shown. Sand and polish the work, and use the dividing head to locate the three holes into which the uprights are dowled. The base may then be removed from the faceplate and ½" holes bored ⅜" deep.

The walnut for the wheel rim should be ¾" thick and 7½" square. When mounting it, a piece of waste wood ¼" thick should be placed between the work and the faceplate. Be sure that the faceplate screws are not more than 1½" from the center. The stock is cut down to 7" in diameter, turned to shape and sanded.

Mark the position of the six spokes as well as the six alternate positions for boring the pipe-stem holes through the wheel. With the parting tool, cut out the center to clear the largest diameter of the jar. Make the last thin cut by hand with a sharp-pointed knife.

On the underside of the wheel, lay out the three holes into which the tops of the uprights will be dowled. Drill ½" holes, ¼" deep. Next make the ⅞" holes for the pipe stems, boring halfway through from opposite sides to avoid splintering. If an auger bit is used, drill a small hole the size of the lead screw first in order to prevent feeding too fast and splitting the wood. Now place the rim in the vise and bore ¼" holes ½" deep for the spokes.

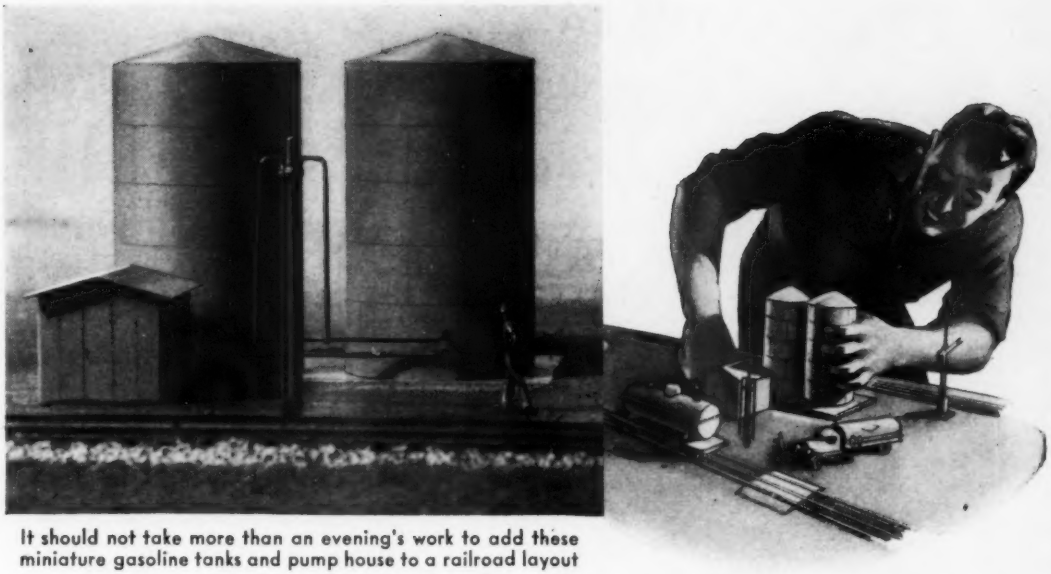
Turn the spokes from ¾" square maple stock 3" long and leave ¼" doweled ends ½" long to fit into the rim. Also turn three uprights from stock 1" square and 5" long, leaving ½" doweled ends ¼" long at each end. While the length of these uprights is given, it is well to take the actual measurements with the jar in place.

The lid is turned from ¾" stock. Use the single-screw faceplate and turn the underside first. Cut the lid large enough to cover the jar and allow about ⅛" overlap all around on the inside rim of the wheel. Rabbet around the edge to fit the inside diameter of the jar and turn out a recess about 2" in diameter and ¼" deep in the center of the lid to receive a sponge-rubber humidifying disk. Reverse the work on the faceplate and complete the turning. The knob may be turned between centers and fastened with a flathead screw.

Any desired finish may be applied, but it is advisable to sand, stain, and finish all parts while they are in the lathe.—LLOYD L. REISE.

Improvised Shield for Eyes

WHEN doing dusty work that may endanger the eyes, an improvised shield can be made from transparent cellulose tissue cut to cover both eyes and fastened to the face with a strip of adhesive tape. Of course, this cannot be used for heavy work—a pair of safety goggles is always a good investment for the amateur craftsman.—C. R. AVERY.



It should not take more than an evening's work to add these miniature gasoline tanks and pump house to a railroad layout

Gasoline Storage Station

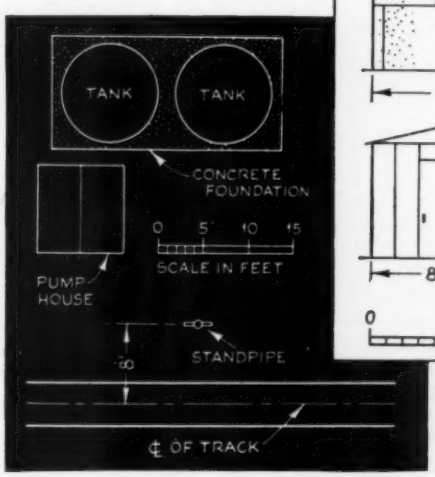
FOR MODEL RAILWAY

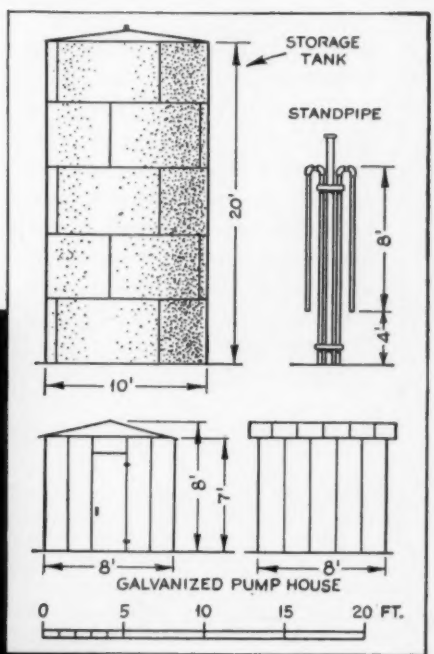
ONE of the less common model-railway accessories is a miniature gasoline storage station. The tanks may be made of two or three layers of writing paper, glued up over a cylindrical form, with a conical top of the same material. A piece of gray cardboard is used for a concrete foundation.

The galvanized-iron pump house is also made of writing paper or lightweight cardboard. The four sides are laid out as a single unit, then folded at the corners. Be sure and leave enough paper to form a flap for gluing.

Two paper clips and a short piece of slightly larger wire are used for the standpipe. Since the model illustrated in the photograph is built to "HO" scale, the arms of the standpipe are too small to have a flexible union and so cannot be raised or lowered. Paper clips were straightened and used for pipe lines.

The tanks and pump house are painted light gray and the seams then penciled on.—J. W. CLEMENT.



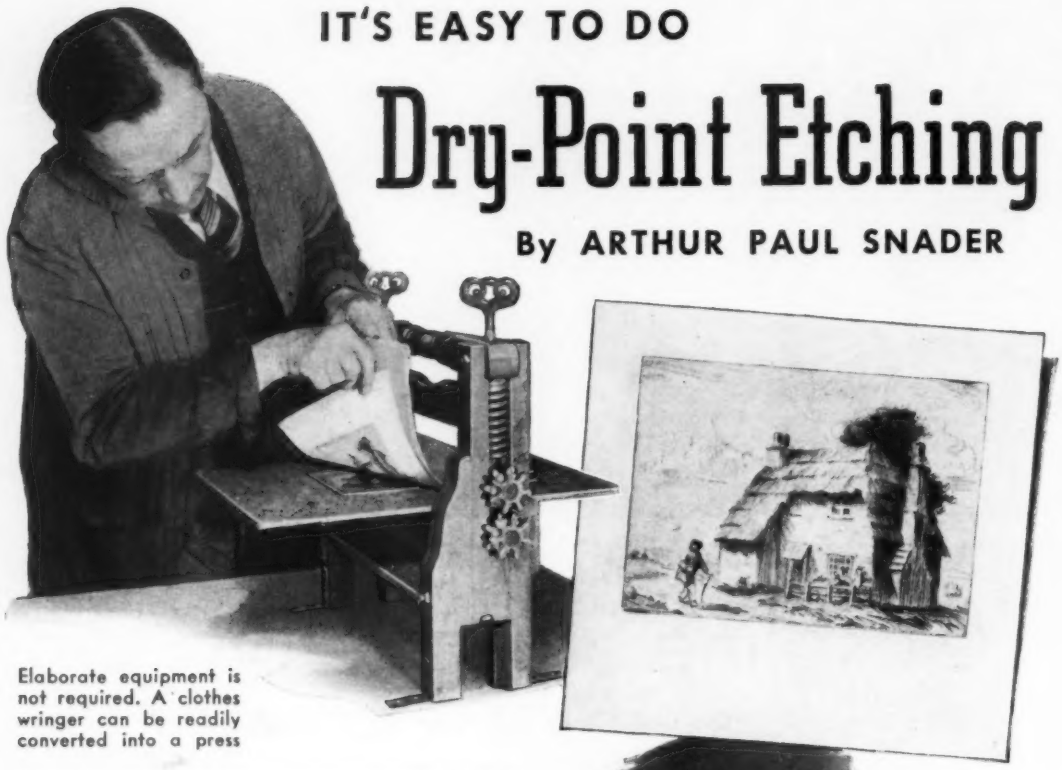


The parts and how they are set up in relation to the track. All dimensions are in feet to make it easier to build to any scale

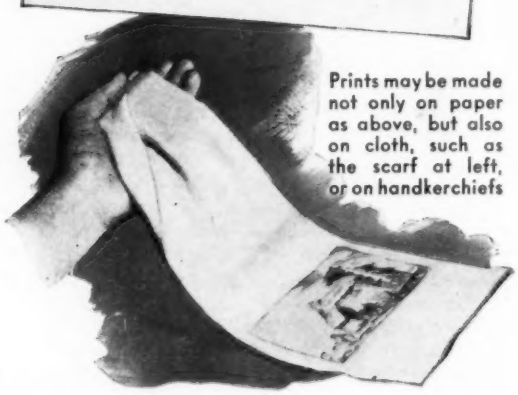
IT'S EASY TO DO

Dry-Point Etching

By ARTHUR PAUL SNADER



Elaborate equipment is not required. A clothes wringer can be readily converted into a press

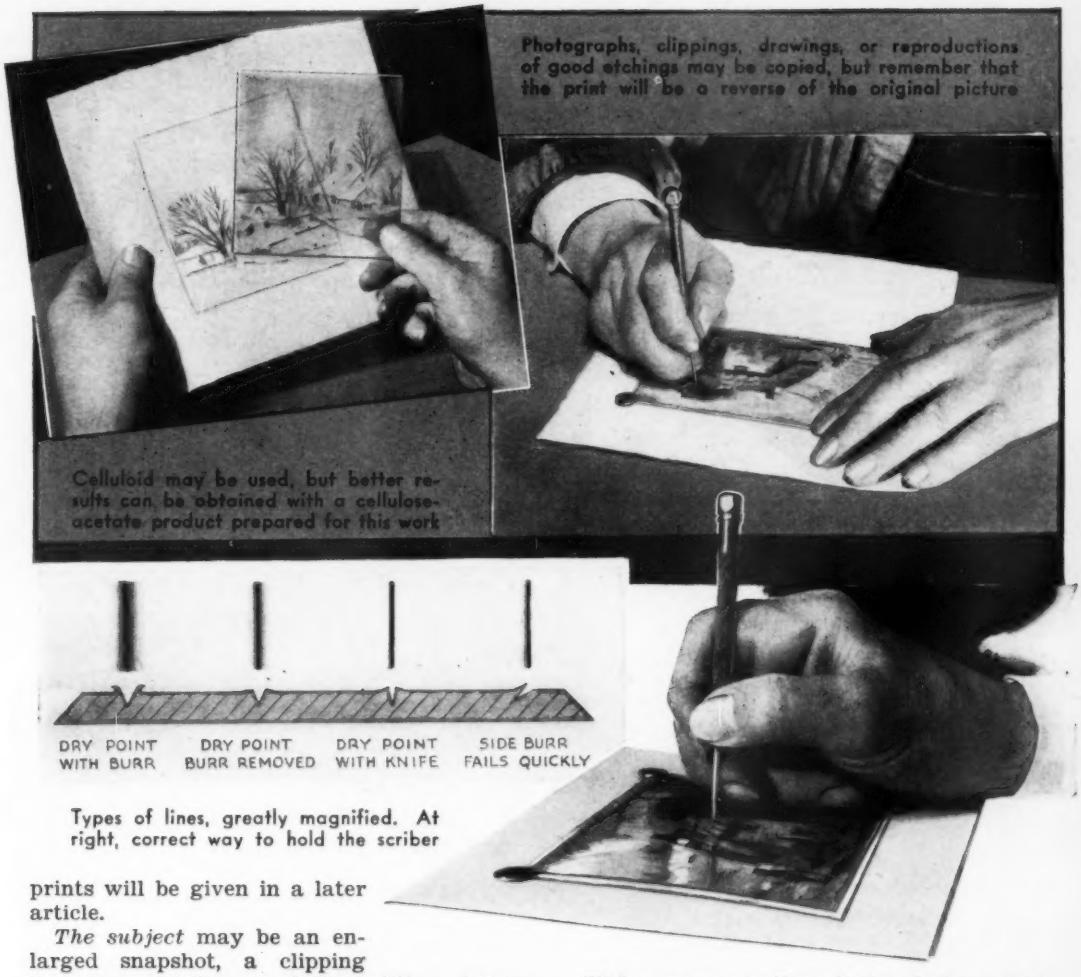


Prints may be made not only on paper as above, but also on cloth, such as the scarf at left, or on handkerchiefs

For years Arthur Paul Snader has printed etchings for many of the country's leading etchers. Among them are Albert Sterner, Roland Clark, and Marguerite Kirmse. He has also taught etching, one of his most famous pupils being the Grand Duchess Marie of Russia. He is head of the Summer School of Print Making, Provincetown, Mass., and author of "Apsolite Etching—What It Is and How to Do It," "How to Make Fine Prints," and numerous articles.

FEW crafts have greater appeal for the artistically inclined than making dry-point pictures on thin sheets of celluloid or other transparent cellulose material. These are then printed on paper just as if they had been made on copper. As wall pictures, they will grace any room in which they are hung; and as seasonal greeting cards, they have a distinctive and expensive appearance. They can also be printed on silk and used for making beautiful scarfs, handkerchiefs, bookmarks, and similar articles. Best of all, the work is simple, inexpensive, and can be mastered by anyone. Even a knowledge of drawing is not essential.

Equipment. A scriber obtainable at any hardware store for about 35 cents is needed. It consists of a pin vise with a point that can be reversed for carrying. You can also use a very small pin vise for holding phonograph or sewing needles. The plates may be ordinary celluloid sheets such as are used in automobile curtains, but better results may be had with one of the cellulose-acetate materials (0.020" thick) available at well-stocked art supply shops. A drawing board, small hone or sharpening stone, some thumb tacks, and a piece of white paper complete the equipment. Materials for making the


Photographs, clippings, drawings, or reproductions of good etchings may be copied, but remember that the print will be a reverse of the original picture
Celluloid may be used, but better results can be obtained with a cellulose-acetate product prepared for this work
DRY POINT WITH BURR
DRY POINT BURR REMOVED
DRY POINT WITH KNIFE
SIDE BURR FAILS QUICKLY

Types of lines, greatly magnified. At right, correct way to hold the scriber

prints will be given in a later article.

The subject may be an enlarged snapshot, a clipping from a magazine, or, better still, a reproduction of a good etching. Keep in mind that the final print will be a reverse of what you copy.

Sharpening the dry-point needle. Lay the tool across the fingers of the left hand, pointing outward past the thumb for 1″ or more. Close the right hand over the left hand with the needle protruding between the first and second fingers. Allow the point of the needle to roll lightly upon the hone at a slight angle while moving the right hand up and down the fingers of the left hand as illustrated. Just a few turns from time to time will keep it sharp.

To make the plate, place the subject on the drawing board and upon this lay a piece of plastic cut large enough for a ½″ margin all around the picture and 2″ at the top for practice space. If the plastic has a tendency to curl, tack it down with the convex side up.

How scriber is rolled across a small hone to sharpen the point

Make some practice strokes before starting the picture. The tool must be held absolutely erect at all times. Strokes may be made in any direction. The greater the pressure, the greater the depth and width of the line and the blacker it will print. Types of lines are shown in one of the drawings. To obtain a softer, grayer line, remove the burr by pushing the thumb nail along the line as though it were a delicate chisel.

A sharp-pointed knife (such as surgeons' scalpels, small frisket knives, and the like) may also be used after one is proficient with the needle. With these tools, the lines are cut in, and the resultant burr is very smooth and clean. Parts done in this manner will be a little sharper or "colder" than work with a needle.

Bear in mind that depth in a picture is obtained not alone by reducing the size of the more distant objects, but by making them

grayer. They also are lacking in detail compared to objects in the foreground. Therefore, do all distant work with a progressively lighter stroke.

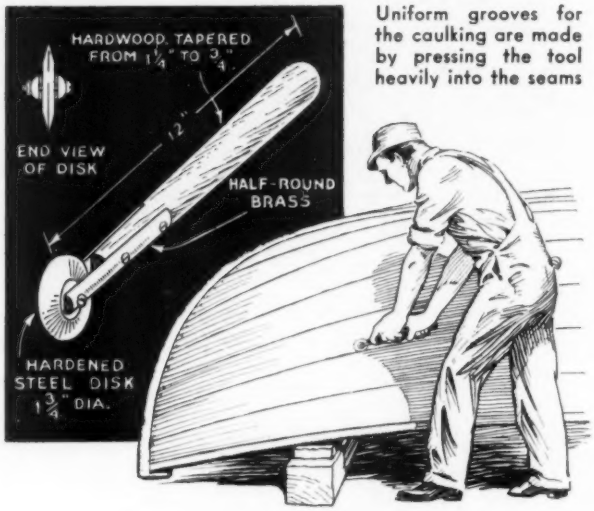
Occasionally insert a sheet of plain white paper between the picture you are copying and the plate; you will then be able to see very clearly the work that has been done. By slightly tipping the plate up toward the light as you look across it, the gray lines will appear black against the uncut surface.

When the picture is completed, remove the thumb tacks and, with ruler and sharp knife, score a fairly deep line entirely around the edges of the picture. Now bend the material backward along the score, and the plate will break cleanly.

(TO BE CONTINUED)

Steel Roller Prepares Boat Seams for Caulking

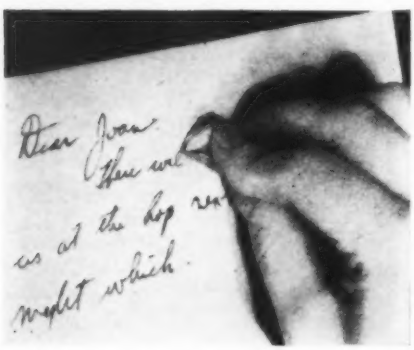
A ROLLER-DISK tool made as shown is an aid in preparing the seams of a new boat for caulking. It is provided with a stout hardwood handle (tapered from 1¼" to ¾" near the disk) so that heavy pressure can be exerted as it is rolled along the seam, making a uniform V-groove.—H.S.



Uniform grooves for the caulking are made by pressing the tool heavily into the seams

Sandpaper Erases Ink in an Emergency

INK erasers are not always at hand when needed, but an efficient one can be made in an emergency by gluing a piece of fine sandpaper around a small block of wood.—R. DeW. M.



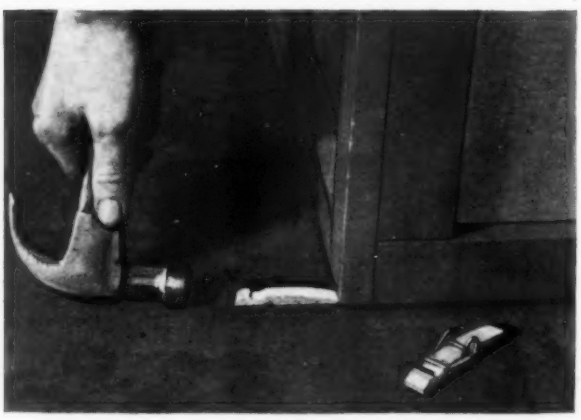
Glued around a small block of wood, a piece of fine sandpaper serves as an ink eraser

Marking Ship-Model Deck

LINES to imitate the deck planks on the hull of a small ship model may be marked by using a bolt of such a size that the threads are the right distance apart to form a multiple scriber. Draw the bolt slowly and firmly along the deck, taking care that it merely slides and does not turn. This will give you uniform plank markings, but the slightest turn of the bolt will spoil the effect.—EDWARD R. WEBER.

Hardwood Wedges Obtained from Spring Clothespins

SMALL hardwood wedges are sometimes required for leveling a stove, cabinet, or other heavy article of furniture. They can be obtained in a moment by removing the wire spring from an ordinary spring-type wooden clothespin. The two halves make excellent wedges, which can be cut off as necessary.

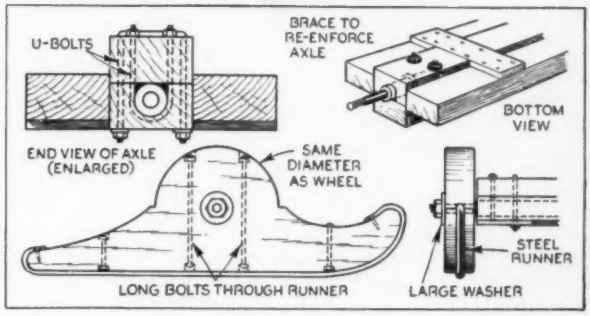


Sled Runners
EASILY ADDED TO
Soap-Box Racer

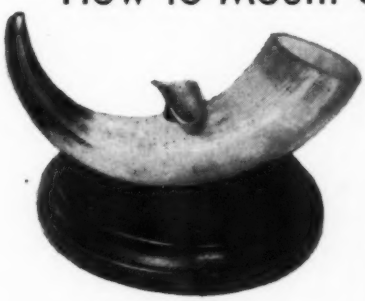
MANY thousands of well-built soap-box derby racers are laid up during the winter, but a number of these could be adapted for healthful winter sport by mounting small sled runners in place of the wheels. Dimensions and construction will vary to some extent, but in most cases it is necessary to reënforce each axle heavily.

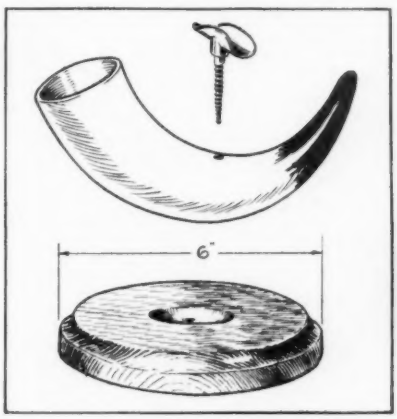
The runners are cut as shown and bored a drive fit for the long vertical bolts, which prevent splitting. The shoes are round cold-rolled steel from ¼" to ½" in diameter. Notch these runners at the ends so the shoes will be held very firmly when fastened with screws as indicated. Drill the holes for the axles square with the face of the runners and oil them well.

Brakes of the "drag" variety, common on soap-box racers, are easily adapted for use on snow and ice by adding spikes.—JACK HAZZARD.



How to Mount a Horn to Serve as an Ash Tray





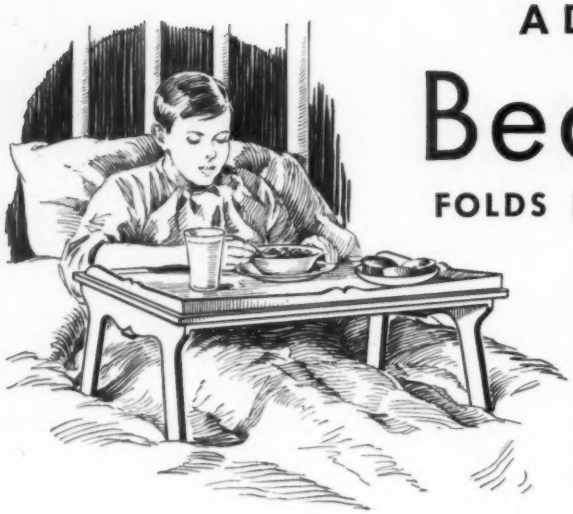
The base is turned from wood and scooped out to receive the horn. Below, sanding the horn with a drum on a flexible shaft

SYMBOLIC of the West with its herds of cattle, this ash tray is a highly polished horn mounted on a turned wooden base. Horns may be obtained at the smaller packing plants, on some farms, and from various dealers. If the horn is very dry, the bone can be removed by gripping the end in the vise and giving the horn a twisting pull. If this fails, the bone is removed by boiling the horn until the connecting tissue has been cooked loose.

Nicks and other imperfections are removed with a hand scaper or a small sanding drum in the lathe or on a flexible shaft. Finish with sandpaper of the finest grade.

The cigar rest is shaped from brass, copper, or nickel silver. A short post of the same material is made to fit under it, and the pieces are soldered to the head of a wood screw, which passes through the horn and into the base. Finish the entire piece with clear lacquer. This does not turn the horn yellow, and it can be rubbed to a high polish when dry.—D. C. MARSHALL.

ADJUSTABLE
Bed Table
FOLDS FLAT FOR STORAGE

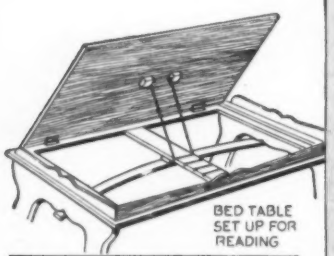


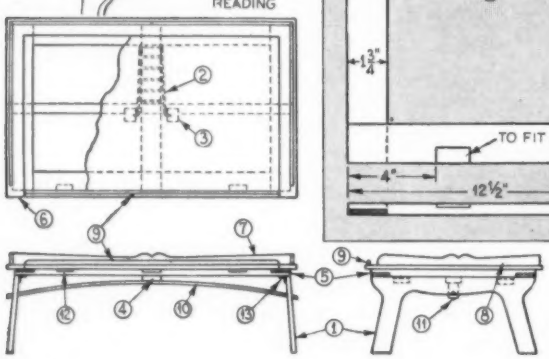
When someone is ill, this table is a great convenience

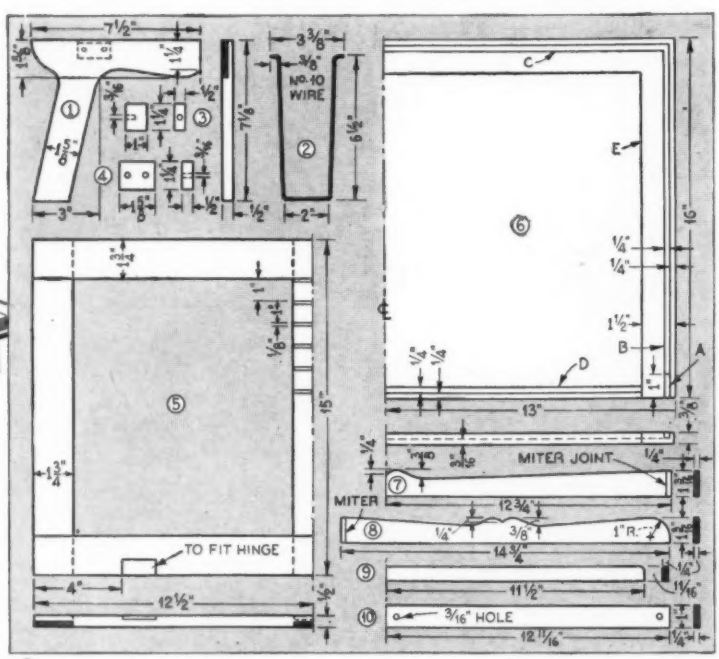
ILLNESS comes unheralded and unwelcomed to every home, and when it does the world becomes strangely and suddenly confined within four narrow walls. Hours spent in bed from necessity are more than sixty minutes long, and the little work required to build this bed table will be a welcome contribution to shortening those endless hours.

It is light and easy to carry, yet amply strong. Meals may be arranged on it in the kitchen and carried in as on a tray. Its enameled surface is easily cleaned, and it is then ready for building blocks, jig-saw puzzles, playing cards, and other games. For reading, or writing, the top may be raised to the desired angle. No weight comes on the user, and there is plenty of room for freedom and changing positions. When the table is not in use, fold it up and slip it into the closet or on a shelf.

Whitewood or clear pine may be used, the former being stronger, with three-ply fir for the top. After cutting dadoes *B* and *C*, fit in little pieces of wood where the dadoes are not needed, as at *A*. Dado *D*, into which part 9 fits, cannot be cut until the margin of 6 has been sawed along *E*. Part 11 is a No. 6 roundhead screw; parts 12 and 13 are 1½" narrow brass hinges. The brace for the legs should be maple.—ROLLAND R. GOVE.



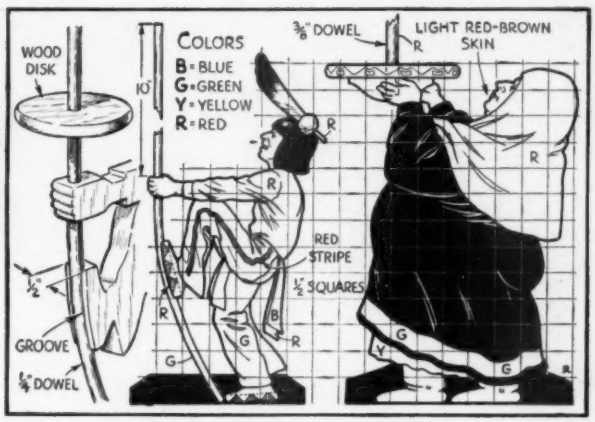




Dimensioned drawings for the parts and, at left, the assembly. Three-ply fir is used for the top, and whitewood or clear pine for the others parts. Maple is best for the brace

Indian Figures Hold Doughnuts

These colorful holders are made and painted as shown in the working drawings at right



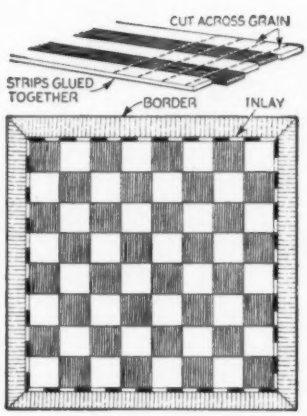
SCROLL-SAWED in the form of an Indian squaw and an Indian boy, these holders for doughnuts or pretzels add a bright, novel touch to the table.

The figures are sawed from ½" thick plywood or white pine. Drill the pieces to receive the rods, which are wooden dowels ¼" in diameter. In the case of the Indian boy, holes will have to be drilled through the hand and into the base, and a groove cut in the edge of the raised foot. Wooden disks are drilled to fit the dowels snugly and glued in place as a base on which the doughnuts or pretzels may rest. The figures are then mounted on wooden bases of any suitable size and weight.

One color scheme is indicated on the drawings. The areas that appear solid black are, of course, painted that color. Time may be saved in painting by the use of opaque water colors, but a coat or two of transparent varnish should then be applied. If enamels are preferred, apply a coat of flat white first and sandpaper it smooth.—GRAY WOLF.

CHECKERBOARD

[*WOODWORKING*]



Cut four strips of dark veneer and five of light, making them a little wider and longer than actually needed. (Four strips of light will do, but if five are used, the construction is a little easier.) Nail them between two pieces of ½" hardwood stock, plane one edge, then gauge the width and plane the other edge. Stretch paper over a drawing board and glue the strips to the paper, edge to edge, with liquid glue, and wait until dry. Cut eight strips across the grain, a little wider than required. Trim to width between the hardwood boards as before. Lay out and glue them to paper with liquid glue to form the checkerboard. Cut away the projecting light-colored squares. Add a veneer border if desired. Now glue the veneer, paper side up, to a crossbanded core with casein glue. When dry, moisten paper and peel it off.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Skillful Craftsmanship

BY MEANS of posters, newspaper advertisements and articles, and window displays, the ***Fairmont (W.Va.)*** Homecraft Club, an affiliate of the National Homeworkshop Guild, was able to make its first exhibition a highly successful one. More than 1,100 persons attended during the three days of the show.

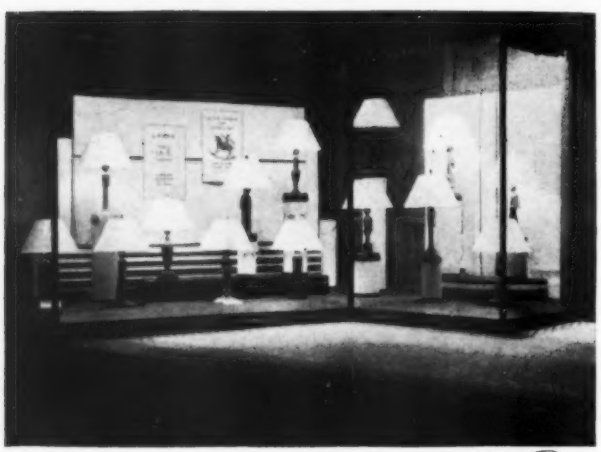
Secretary William M. Hamrick reports: "We had 101 projects on display, ranging from candlesticks and book binding to a high-intensity telescope. We had a complete shop set up, although it could not be operated full time because of the crowds and the dust created. Over 1,200 puzzles were made on the job and distributed as souvenirs. Wooden badges were worn by all the members. The printing on them was done by Archie Koon and B. L. Bell."

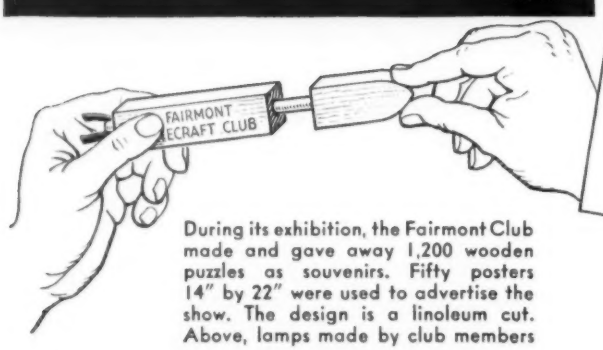
Previous to the show, the club entered a contest to design lamps made to I.E.S. specifications for the local public service company. The winner was Mr. Bell, who made a duplicate to be given as a prize.

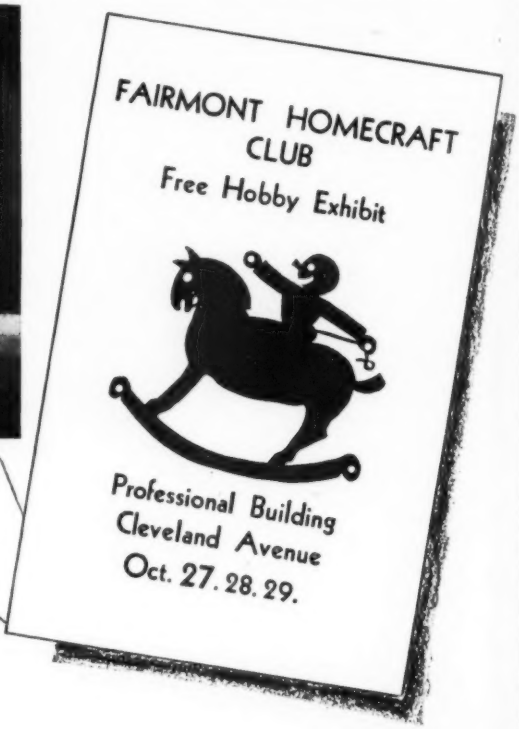
The following clubs are scheduled to hold exhibits during February and March: ***Lincoln (Nebr.)*** Homeworkshop Club, North West Homeworkshop Club of ***Chicago, Ill.***, ***Ottawa (Ont., Canada)*** Society of Model Engineers, ***Peekskill (N.Y.)*** Homeworkshop Club, ***Onaway (Mich.)*** Wood Carvers, and ***Long Beach (Calif.)*** Homecraftsmen Club.

Those who displayed their craftwork during January were the ***Ashtabula (Ohio)*** Homeworkshop Club, ***Orange (N.J.)*** Homecraftmen Club, Mount Royal Hobby Club of ***Montreal, P.Q., Canada, Dawson (Minn.)*** Homecraftsmen, ***Lexington (Ky.)*** Home-

1,100 ATTEND SHOW IN FAIRMONT, W. VA.—WATCH DEMONSTRATIONS—RECEIVE SOUVENIRS







During its exhibition, the Fairmont Club made and gave away 1,200 wooden puzzles as souvenirs. Fifty posters 14" by 22" were used to advertise the show. The design is a linoleum cut. Above, lamps made by club members

Displayed by Club

AT HOME WORKSHOP EXHIBIT

The Fairmont exhibition had a constant stream of visitors during the three days it was open. Each of the members in attendance wore a badge like that at the right—a 3" disk of thin plywood printed with a green hobbyhorse

crafters, and *Vicksburg (Miss.)* Homeworkshop Club.

Phillip Pickett has been elected president of the Witch City Homeworkshop Club, *Salem, Mass.* The barn belonging to the secretary, John W. Pszenny, has been transformed into a clubhouse. A new roof was laid and a workbench installed. The members decided to build a lathe out of old auto parts to be used until money can be raised to purchase a new one.

Melvin Baer has donated fifty new books to the library of the Bison Builders Guild, *Buffalo, N.Y.*, which now has over 600 volumes. All the members are working on an HO-gauge model railroad. Officers for 1939 are Leo Beyer, president; Edward Dinehart, vice president; Raymond Baer, secretary; Melvin Baer, treasurer and librarian; George Harris, sergeant-at-arms.

Members of the Ship Craft and Model Engineering Guild, *Cincinnati, Ohio*, are building five model yachts of the 50-800 class designed by the secretary, William Richards. Also under construction are two models of the U.S.S. *Alabama* and a hydroplane.

To increase interest among the members, the Lewis-Clark Homeworkshop Club, *Lewiston, Idaho*, is sponsoring a monthly exhibit of one-evening projects. After the meeting the articles are auctioned off and the money is put into a fund to finance a permanent meeting place and shop. New officers are Ira S. Dole, president; Elmer Leaf, vice president; H. T. Anderson, secretary; O. Ranzenbach, treasurer; P. J. Rawson, librarian.

Calvin Robles spoke on "How to Make a Talking Picture Machine and Talking Pictures" at a meeting of the *LeRoy (N.Y.)* Homeworkshop Club . . . Rufus Charles demonstrated patch veneer laying before the Tri-City Homeworkshop Club at the home of Earl Gealow, *LaSalle, Ill.* . . . The *Wood-*

Ridge (N.J.) Homeworkshop Club went on an inspection tour of the main office of the Western Union Telegraph Co. in New York . . . The Chickasaw Homeworkshop Club, ***Memphis, Tenn.,*** recently enjoyed a demonstration on refinishing walnut . . . New officers of the ***Racine (Wisc.)*** Homeworkshop Club are John Nelson, president; Fritz Peterson, vice president; Clyde E. Ford, secretary.

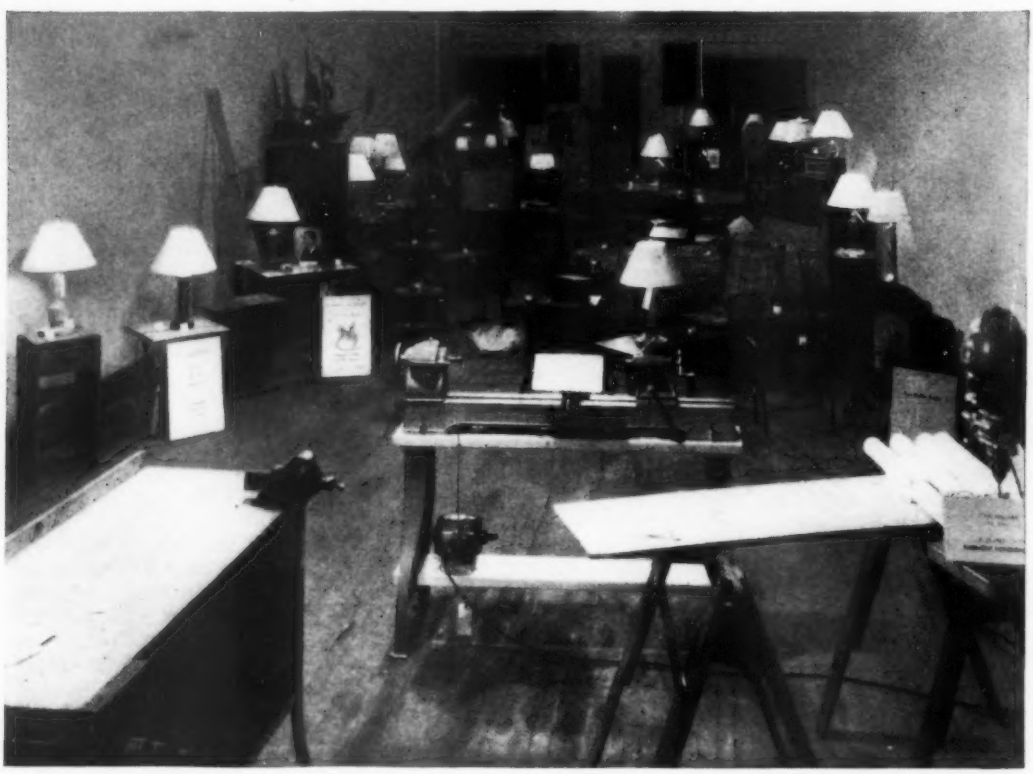
Bookcases and a large blackboard have been installed in the clubroom of the ***Fall River (Mass.)*** Homecraft Club. Recent programs included two moving pictures, a demonstration of furniture upholstery by Walter Sweeney, and a jig-saw exhibit by Bernadine Lafond. Those in charge of the annual Christmas project were Clifford Schlemmer, Mr. Sweeney, and George Legault.

The ***Ottawa (Ont., Canada)*** Society of Model Engineers is busy making new airplanes and model trains. Secretary G. B. O'Connor says, "It is with sincere regret that I report the untimely death of one of our oldest members, Dr. Mark G. McElhinney, who was one of the first to own and operate a home workshop in Ottawa. He was 71 at the time of his death. In the course of his long career he built, among other things, several full-size steam engines. He was very fond of the water and by a queer twist of fate was drowned near his cruiser, on which he lived for the past few years."

R. A. Arbuckle gave a talk and demonstration on the manufacture and use of saws before the ***Findlay (Ohio)*** Homecraft Club . . . The ***Sacramento (Calif.)*** Homecraft Club held a craftwork exhibit at the Art Center for two weeks . . . New officers of the ***Creston (Iowa)*** Homeworkshop Club are A. F. Watts, president; A. S. Beatty, vice president; R. R. McGinnis, secretary; LeRoy Winkler, librarian.

The ***Portland (Ore.)*** Homeworkshop Club recently visited the plant of a saw manufacturer and witnessed a demonstration of saw filing and setting by the shop superintendent, Wayne O'Dell.

George Fitzgerald has been elected president of the ***Seattle (Wash.)*** Homeworkshop Club; Charles J. Lowe, vice president; Talbot McGar, secretary-treasurer; M. L. Eggleston, librarian; Earle Landers, shop foreman. An extensive Christmas toy program was carried out by the members, who meet every other week. A membership drive is being conducted under the chairmanship of B. V. Nichols. Plans have been started for a second hobby show.



During the Fairmont show, craftwork demonstrations were given in this temporary shop, set up in the rear of the exhibition room. It was here that the members made the wooden puzzles distributed as souvenirs

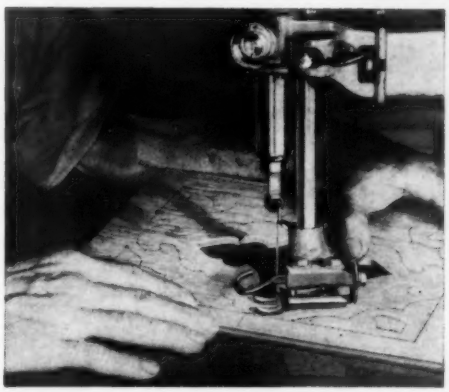
Attractive Inlay Cover for Album or Scrapbook

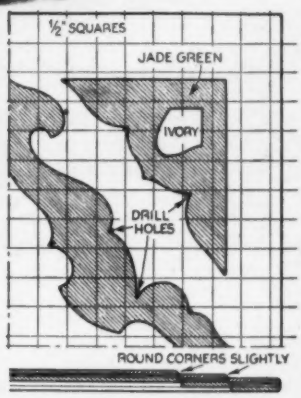
The inlays of this cover have been cut at an angle so as to project 1/16"

SIMPLY by tilting the table of a scroll-saw a trifle, it is possible to make an attractive inlay cover for a photo album or scrapbook from a single piece of ¼" plywood. The effect of tilting the table is to give the cut-out parts a slightly wedge-shaped edge. When the pieces are finally assembled, they can be pushed in so as to project about 1/16" on the other side. The amount of the tilt is determined by experimenting with scrap plywood. Enter the saw blade through small holes drilled in the corners. These are afterwards puttied or filled with plastic composition wood.

Paint all units with enamel, sanding lightly between coats and rubbing the last with pumice stone and water. Ivory and jade green are an excellent combination. The inlay units are then assembled by themselves with glue, and glued into the painted background. Finally, brush on a brown glaze and wipe it off everywhere but in the corners. Clean all surfaces that would naturally receive wear.

You can obtain leaf fillers from albums purchased at ten-cent or stationery stores. Hinge the front as shown and use page eyelets to align the sheets. Either laces or brass bolts may be used as clamps. Paste black paper over the insides of the covers. —LESLIE KINNING.





Quarter Pattern and Section

Plating Small Steel Parts with Tin, Copper, Zinc

Copperplating steel hardware with a solution of bluestone and cream of tartar

SMALL iron or steel parts can be quickly plated with tin or copper by a rubbing-on process. To plate with copper, dissolve half a teaspoonful of copper sulphate (bluestone) crystals in water and then add cream of tartar to the warm solution until it becomes deep blue in color. Brush or rub this solution on the cleaned iron parts with a piece of cloth wrapped around the end of a stick or a thick glass rod. If, however, you wish to tin the articles, first copperplate them, then boil them in a solution of half a teaspoonful of tin chloride and a teaspoonful of cream of tartar in an enamel pot, with a piece of genuine tin foil (such as is used around cheese). By using a solution of zinc chloride and boiling with a sheet of zinc, the object can be zinc plated. Allow the object to touch the tin or zinc.—R.W.

Tables Need

Rubbing down and polishing two tables of a type often made by amateurs—one a butterfly, the other a small, square drop-leaf

SMALL tables are built in greater numbers by amateur craftsmen than any other type of furniture. There are many varieties—end tables, coffee tables, occasional tables, tip tables, book-trough tables, bedside tables, lamp tables, butterfly tables. Since such tables get rather hard usage, they demand a finish highly resistant to wear as well as attractive to the eye.

Whatever the wood or the design, the piece, after the trial assembly, should be carefully scraped and sanded free of all traces of glue. Next, sponge it with a clean sponge and water containing hot liquid glue in the proportion of one cup of glue to 10 qt. clean water. Mix this only in an *enamel-ware* pan or tray. Do not touch the wood at any time with the bare hands during the sponging, or dark spots may result. Dry and sand with 4/0 or 6/0 garnet finishing paper. This process will bring up any small dents

VARNISH AND ENAMEL FINISHES [*PAINTING*]

1. Sand, inspect, stain with non-grain-raising stain, and dry 12 hr. For an enamel finish, the stain is, of course, omitted.

2. Seal with four-hour floor varnish reduced 50-50 with pure turpentine. Dry 24 hr. Sand with 6/0 paper if necessary.

3. If wood is open grained, fill with silex filler colored to match. Dry 48 hr.

4. Apply a sealer coat as described for operation No. 2 after using a rag and gasoline to see that no traces of filler are left near joinings or on moldings and turnings. Dry 24 hr.

5. Brush or spray on four-hour varnish or enamel as required. Dry 48 hr.

6. Sand with 6/0 garnet finishing paper. Apply second coat.

7. If last coat is plump and level after three days, rub for finish with water and FFF pumice stone; otherwise apply a third coat, dry three days, and oil- or water-rub with pumice. Clean off, apply a good furniture polish, and let stand a week to reharden if possible before using.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Good Finishes

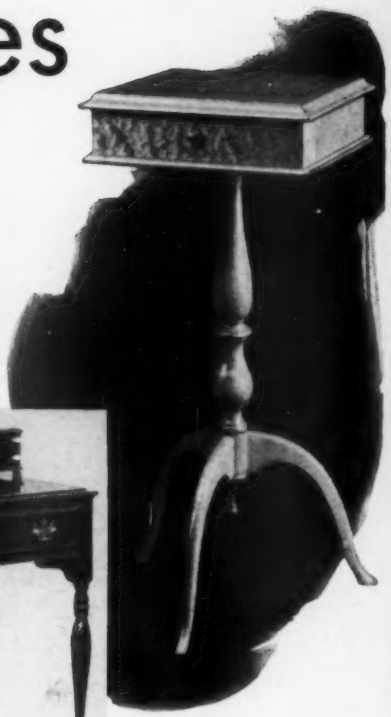
By RALPH G. WARING

or pressed-down grain. Test all sanded surfaces with the finger tips as well as by eye. All sharp, square edges must be slightly rounded.

Best results in staining are obtained with the modern, non-grain-raising type of stain. Various vehicles are available in which the stain powders are dissolved, and some are then reduced to working consistency with hot water. The stain may be applied with a spray gun or wide rubber-set brush of the kind having no tin ferrule. Wiping with clean rags will give even color tones or shaded and high-lighted effects, as desired. Dry overnight if possible.

On maple, birch, beech, basswood, or poplar, no fillers are required, but fillers are generally needed for mahoganies, oaks, walnuts, or similar open-grained woods. Before fillers can be applied, some form of sealer should be used.

Much of the beauty of this spinet desk lies in the flawless finish



Figured woods, such as the maple used in this piece, require a clear and transparent finish

SHELLAC-LACQUER FINISH [*PAINTING*]

1. Sand, inspect, stain with non-grain-raising stain, and dry 12 hr.

2. Spray or brush a light but uniform coat of the following: 3 parts of 4-lb. stock white shellac and 1 part orange shellac thinned with 6 parts denatured alcohol made for this purpose. Dry 3 or 4 hr. (Note: If this type of finish is used for open-grained woods, the wood must now be filled with silex filler colored to match, dried 48 hr., and sealed with a coat of the mixture just mentioned after being sanded as in operation No. 3.)

3. Sand clean with 6/0 garnet finishing paper moistened on back to increase flexibility. Avoid sanding white edges on tops or moldings.

4. To the mixture described in operation No. 2, add 2 parts white shellac, then stir into it an equal volume of shellac-mixing lacquer to increase toughness and resistance to moisture. (Or use clear brushing lacquer instead of the shellac-lacquer mixture.) Spray or brush on two or more coats. Dry hard and sand smooth between applications.

5. Rub last coat with FFF pumice stone, crude oil, and felt. Wipe clean and dry. Clean off with a good furniture polish.

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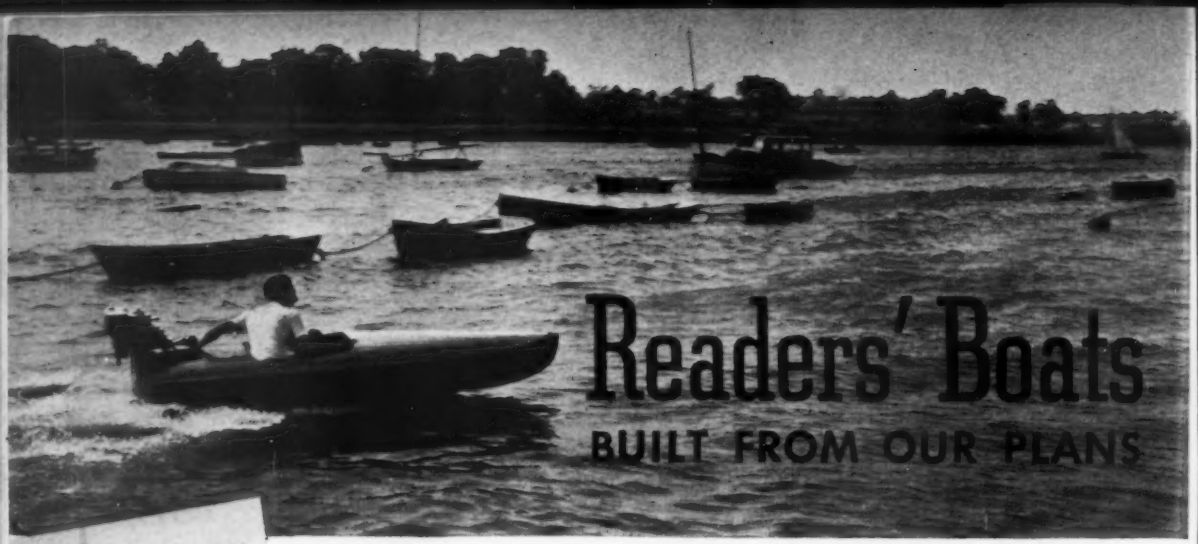
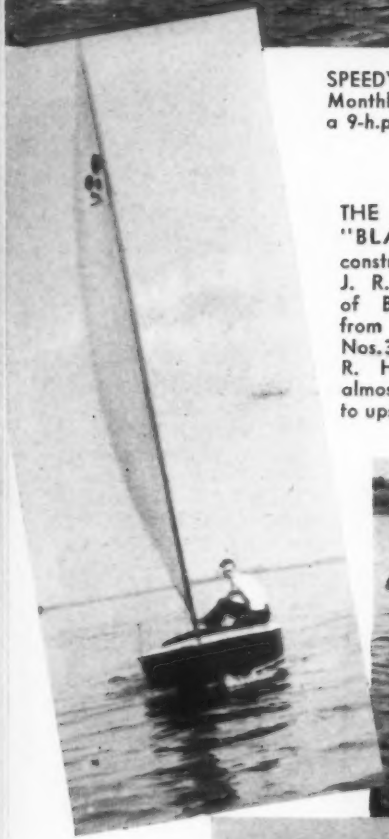


Readers' Boats
BUILT FROM OUR PLANS

SPEEDY SPORT RUNABOUT built by Eddie Dida, of New York, from Popular Science Monthly Blueprints Nos. 309-310-R. The light, sturdy hull is 9′ 8″ long. With a 9-h.p. motor, this extraordinarily fast boat has been clocked at 30 miles an hour



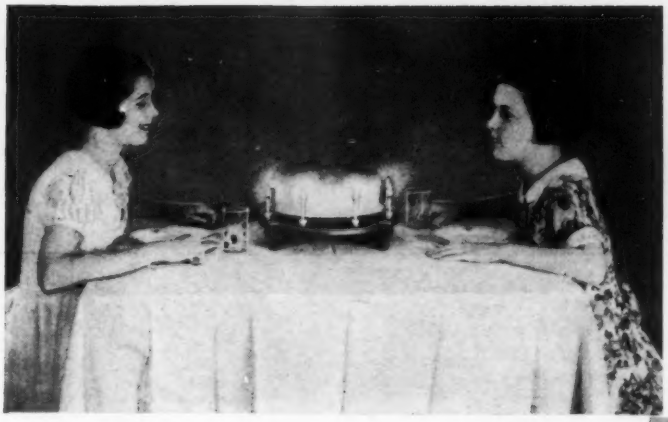
THE SAILBOAT "BLACKCAT" constructed by J. R. Hendricks, of Bristol, Pa., from blueprints Nos. 321-322-323-R. He says it is almost impossible to upset the boat

THE economy and fun of building a boat have tempted thousands of readers of POPULAR SCIENCE MONTHLY to construct a wide variety of small craft. Some of them never undertook such a project before, but our plans and instructions are so simplified that they experienced little or no difficulty. Further information about the boats pictured on this page will be found in the blueprint list given elsewhere in the magazine. An illustrated leaflet will be sent free upon receipt of a self-addressed, stamped envelope.

SECTIONAL BOAT IS EASILY CARRIED

From our blueprints Nos. 340-341-R. Arthur Dunn, of Summerside, P. E. I., Canada, built this rowboat for W. E. MacDonald, of Ottawa, Canada. It is carried in a removable cradle over the rear bumper of an auto as illustrated in the photo below

THE MOTORBOAT-ROWBOAT at left is the first boat that Clifford Colmer, of Peterboro, Ont., Canada, ever attempted to build. The 13′ hull seats four adults comfortably. Although racy looking, it has proved seaworthy in rough water



The disk may be turned over and used to support a bowl, as below

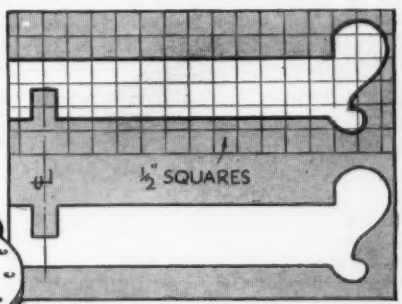
Wooden Stand Gives Better Display to Birthday Cake

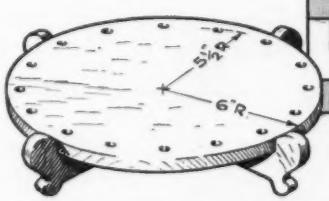
A BIRTHDAY cake and candles can be displayed to better advantage on a holder of the type illustrated. After the birthday party, the top of the holder may be turned over to conceal the candle holes and used for supporting a fruit basket or a flower bowl.

The three parts are jig-sawed from ½" wood, preferably walnut, mahogany, or maple to match the table on which the holder is to be used. Both parts of the cross support may be sawed at one time if two pieces of wood are tacked together, but in cutting the joint, note that one slot is sawed in from the top, and the other from the bottom. Drill the holes to suit the candles in the disk ½" from the edge and only part way through the wood. Carefully sand the rim of the disk so it may easily be reversed.

Fill the wood with a paste filler stained to the color desired, and either use varnish or simply apply boiled linseed oil with a soft, clean cloth after the filler has had time to dry.

Because no nails or screws are used, the stand may be taken apart and stored, if desired.—GEORGE A. SMITH.

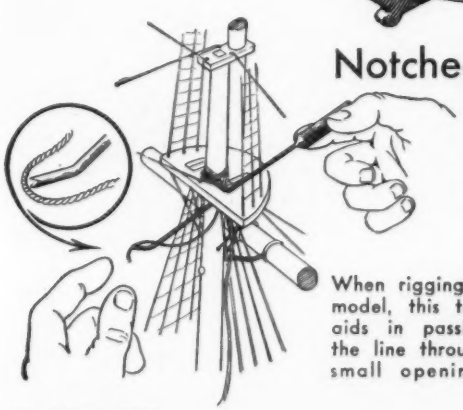




Pattern for cutting the cross support and, at left, how the holes are drilled

Notched Tool Aids in Rigging Models

A TOOL for guiding and belaying the lines used in rigging a ship model may be made from a steel knitting needle. File a notch in the end, and bend the end at an angle to aid in going under rails or through small openings.—S. P. ROBBINS.



When rigging a model, this tool aids in passing the line through small openings

Grip for Electric Shaver

TO PREVENT an electric shaver from slipping out of your hands, snap several rubber bands around the smooth case to provide a nonslip surface.—H. RADZINSKY.

Electric-Iron Element Heats GLUEPOT

A SERVICEABLE electric gluepot of the water-jacketed type may be constructed as shown. In the bottom of the pan used for the base, drill eight ⅛" holes, equally spaced on a 5½" circle, and two holes in the side for the connecting posts. These two holes should be 11/16" apart, center to center, and about 5/16" in diameter. Center the base pan over the bottom of the water container, and mark one hole. Drill this hole and rivet pan to container. Now drill the other seven holes and rivet.

Make the retaining disk from 1/16" sheet iron and three asbestos-paper insulating disks and drill as in Fig. 2. Place the retaining disk over the bottom or base pan and mark and drill the 3/16" holes for attaching. Assemble the electric-iron element, asbestos-insulating disks, and retaining disk, and attach to the base pan with machine screws and washers as in Fig. 1.

Attach the connecting posts to the base pan, being careful that they are well insulated, and connect the leads from the element, one to each post.

Prepare a round hardwood base and cover with two asbestos paper disks. Cut and nail on other asbestos paper disks of diminishing diameters so that they fit within the base pan and amount to a thickness of about ¼". Cut notches in the top disks to give clearance for the element leads. Strips of asbestos paper should be placed around and between the leads to make sure that they are insulated from each other and all other metal parts.

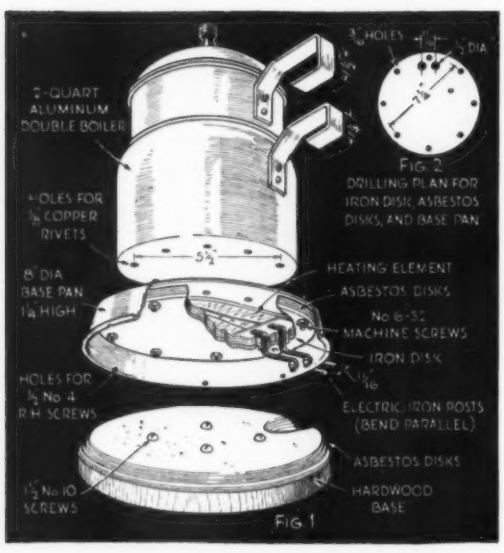


FIG. 1

FIG. 2 DRILLING PLAN FOR IRON DISK, ASBESTOS DISKS, AND BASE PAN

LIST OF MATERIALS

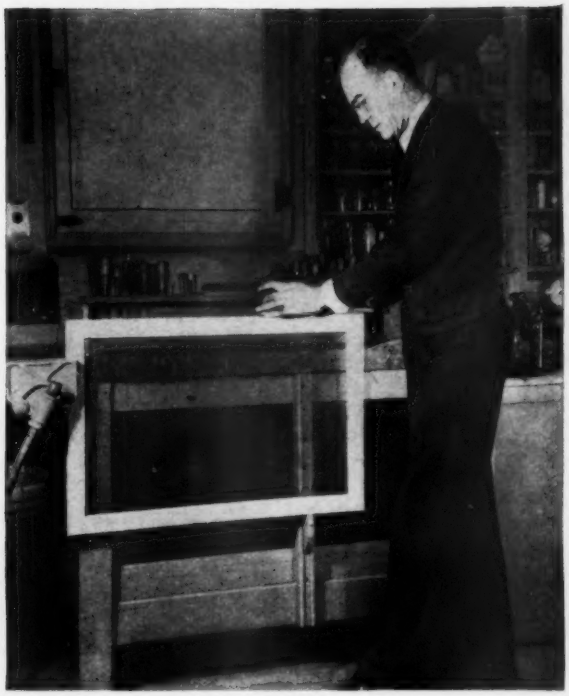
Aluminum double boiler, 2-qt. size. The bottom container will be about 6½" in diameter.
Standard copper-clad electric-iron element.
2 connection posts for an electric iron.
Aluminum or tin pan, 1¼" deep, 8" in diameter, for base.
Iron disk 1/16" thick and of diameter equal to inside diameter of bottom of base pan.
3 asbestos disks, same diameter as iron disk.
8 copper rivets ¾" by ⅛" and burrs.
Hardwood disk ¾" thick and of diameter equal to rim of base pan.
Several asbestos disks to cover base.
4—1½" No. 10 roundhead wood screws.
8—½" No. 4 roundhead wood screws.
8—6/32 machine screws, ¾".

Screw the four No. 10 wood screws in the base to such a depth that the retaining disk will rest on the heads of the screws when the base pan rests on the wood base. The purpose of the screws is to support the pot.

Place the base pan on the wood base and attach with the No. 4 screws driven at an angle through the rim. Bend the handles as shown, and use an appliance cord to the outlet.—E. A. RERUCHA.

Support for Planing Long Work at Bench

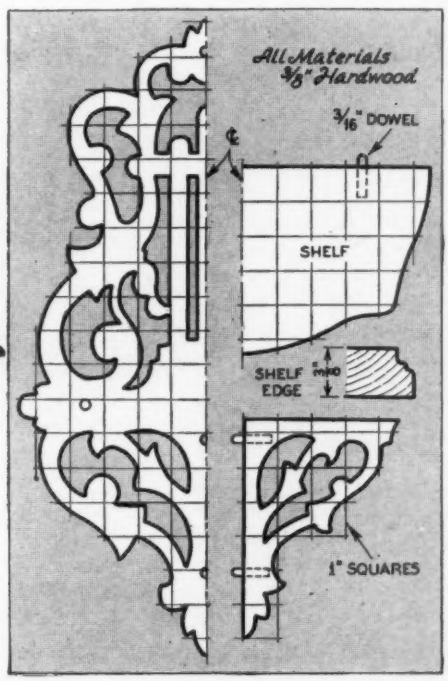
DOORS, storm sash, screens, and other long work can be held conveniently for planing by adding a support to your workbench as illustrated. It is simply a piece of ¾" stock 1½" wide with two ⅜" square strips nailed to one of the 1½" faces in order to form a channel into which the supporting arm will fit. This arm is about ¾" by 2½" by 4", tapered on one end. A ⅜" bolt 3" long is inserted on a downward slant through the upper end. The arm should not extend more than 1" beyond the bench when in place. Drill ⅜" holes at intervals of 3" into the vertical piece at the correct angle to receive the bolt, the end of which should be filed down.—FRANK HEGEMEYER.



Left, inserting the bolt of the arm into a channel hole. Above, planing a screen supported by the jig

Small Scrolled-Sawed Whatnot Has Ready Sale

The shelf projects 5½" and is 11" wide; the jig-sawed background is 19" high. Dowels hold together the three parts, which may be laid flat for storage or mailing



THERE is always a place for an attractive whatnot, and here is one designed to be produced in quantity for sale. It is assembled with snug-fitting dowels and can be taken apart and laid flat for mailing to a customer or for storing in stock. Almost any attractive wood, such as mahogany, walnut, oak, and sycamore, is suitable. The original is made of ⅜" thick gumwood, stained and waxed. First draw full-size patterns and mark them on the wood, then cut out with a scroll or jig saw. The dowels, which hold the parts together, are 3/16" in diameter. —L. R. BROWNE.

Planking Our New

PART TWO

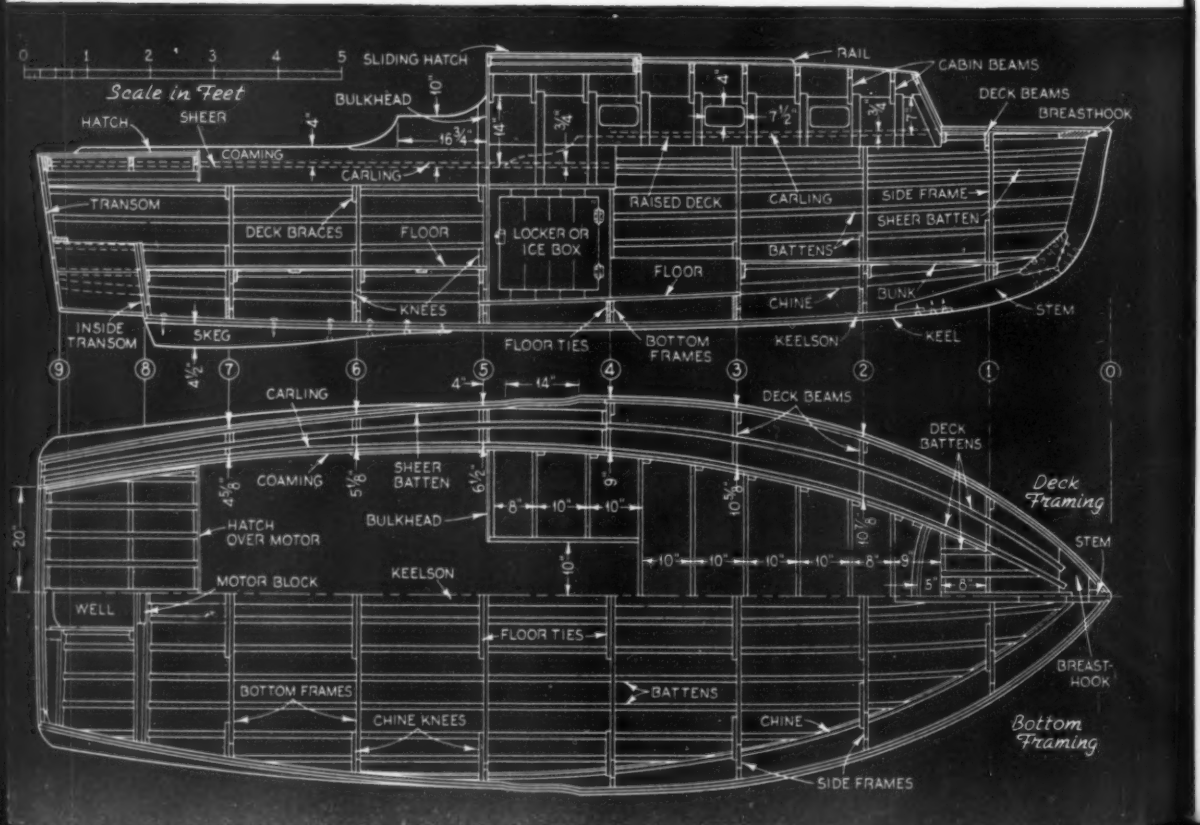
IN CONSTRUCTING the hull of our new 17′ cabin cruiser, it is important that the batten seams of the two transoms and the sides of the motor well should be made water-tight in the same way as the planking seams. The sides of the motor well will act as a transom brace.

The outside transom should be braced in position and the entire framework trued up. Then the chines and all the frames should be beveled so that the planking will fit the framework perf tly. A light batten bent over the framework in various places will show up any slight unevenness.

It will simplify the work if the battens are put in as the planks are fitted rather than all at once. After each plank is fitted, mark along its edge on the frames for the center line of the batten. Fasten battens to frames with 1½″ No. 8 screws. Cut the batten notches only in the transom frame of the outside transom, No. 9, not into the planking. Before starting the planking, notches should be cut in each frame next to the keel to act as limber holes so that water can run from one part of the boat to another. This will facilitate bailing.

Start the planking with the bottom planks next to the keel, which are the garboards. Fit them to the keel and to the stem. To fit a plank, clamp it in position and then mark along the edge to be fitted with a pencil compass or a pair of dividers. It is cut and planed to shape, then clamped in position again for the final fitting. The first two planks on each side of the keel must be wrapped in rags and steamed with boiling water at the forward ends in order to bend them into position. It will make the job of fitting much easier if 4″ planks are used for the first two or three planks on each side of the keel, rather than 6″ widths.

The construction of this boat has been so simplified that even a beginner can build it. Below are drawings showing a sectional side view of the framework and a top view. The scale is merely for obtaining approximate dimensions



Cabin Cruiser

By WILLARD CRANDALL

Designed to give a maximum speed with low-power motors, the boat may be built for less than $100. It is 17′ long, has a 6′ 2½″ beam, and draws 8″ of water.

The planks below the water line should be left open about 1/16″ at the seams to allow for swelling. After the first four planks on each side of the keel are in place, put on the bottom side planks and fit them to the forward ends of these bottom planks. Then the side planks should be dressed down flush with the chines; the remaining bottom planks will merely lap over them.

Just before fastening each plank, coat with marine glue the battens, transoms, transom frames, stem, keel, chines, and all joints that need to be waterproof. Then lay a strip of cotton flannelette over the glued surface and coat the cloth with glue. No cloth or marine glue is necessary for the seams above the water line. When fastening a plank, first clamp it in place and then drill holes for the screws. Use a stop on the drill so that the holes will be the right depth. The

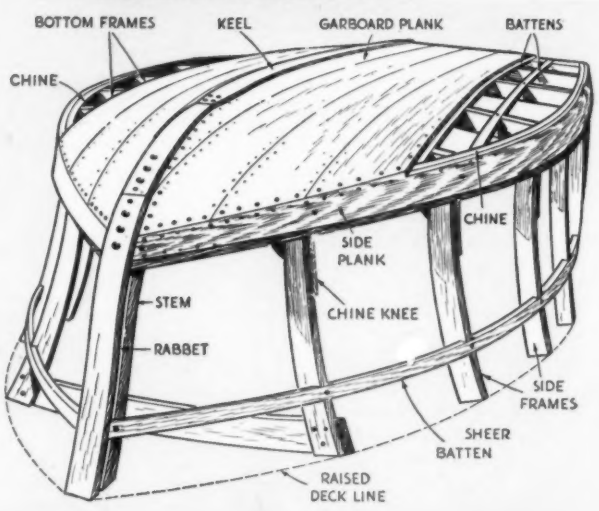
The garboard plank is clamped next to the keel and marked. Then it is planed to shape and screwed in place

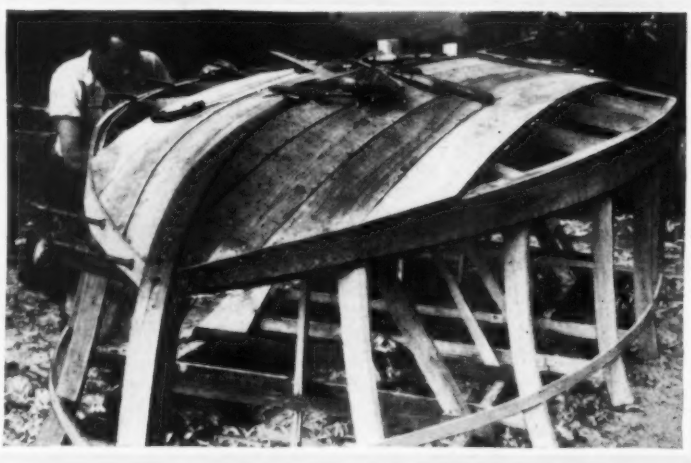
Each plank, after it is shaped, is clamped in position a second time for final fitting

screws should be countersunk enough to allow for covering later with putty or seam composition.

Screw the planks down with flathead screws as follows: (1) Into transoms and transom frames, a double row of 1½" No. 8, spaced about 1" apart; (2) into stem, 1½" No. 8, spaced not over 1" apart; (3) into frames, 1½" No. 8, spaced 1½" apart; (4) into keelson and chines, 1¼" No. 8, spaced about 2" apart. The planks may be fastened to the battens with 1¼" copper or galvanized nails spaced about 2" apart. Holes should be drilled for the nails unless soft wood is used for planking. Clinch the nails by first knocking them over from the inside with a hammer, then hammering on the head while holding a piece of iron against the nail on the inside of the batten. The planks may also be screwed to the battens with ⅞" No. 7 screws, but it would then be best to use oak for the battens.

When the bottom planking is completed, the bottom should be smoothed off, well sanded, and given at least a priming coat of paint.





The bottom side planks are fitted to the forward ends of the first four planks on each side of the keel

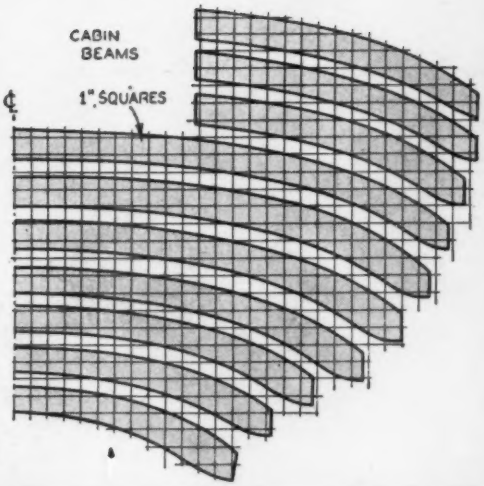
Then the hull should be removed from the form, turned right side up, and braced well. The location of water line No. 2 should be marked on the outside of the planking at each frame because this will form the top of the painted water line.

The side planking is put on in the same manner as the bottom. There are five planks up to the sheer, all of which can be made from 6" widths 18' long. Because of the flare, an 8" width will be necessary for the top side planks on the raised section forward. The breasthook should be fitted before the planking is completed.

If desired, the battens may be entirely eliminated by the use of a caulked-seam construction. In this case ¾" or ⅞" planking should be used in 4" instead of 6" widths; bending will then be easier. When the frame patterns are drawn, allowance should be made for the difference in planking thickness. Each plank should be given a V-shaped caulking seam, fitted tight on the inside and open about 3/32" on the outside to take the caulking. Several strands of twisted cotton wicking can be used for caulking; then fill in with seam composition. Intermediate frames, between some stations at least, would be necessary to take the place of battens in keeping the planks in line. Put these in after the boat is planked. For the bottom these frames should be ⅞" by 1¾", and for the sides ½" by 1¼" bent oak, laid flat.

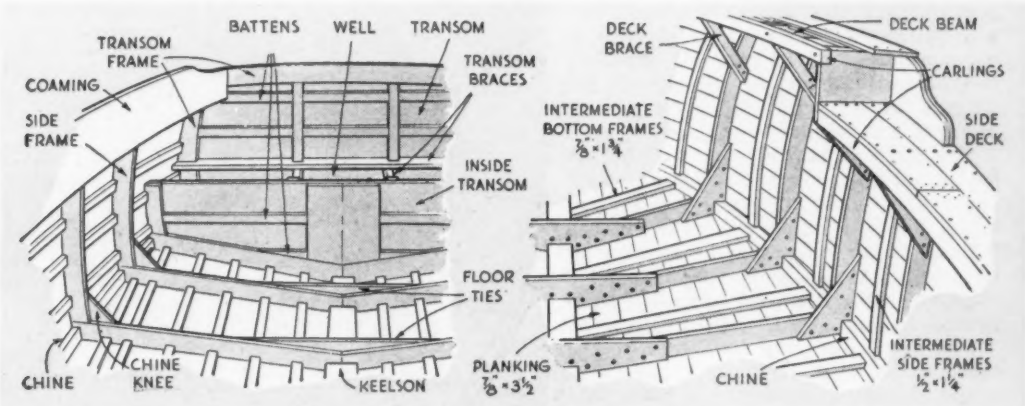
When the side planking is complete, paint the inside of the hull.

(To Be Continued)



The approximate curves of cabin beams. Measurements must be taken to determine exact lengths

Clamping a side plank to the stem. The bottom of the cruiser should be sanded and painted before it is turned right side up



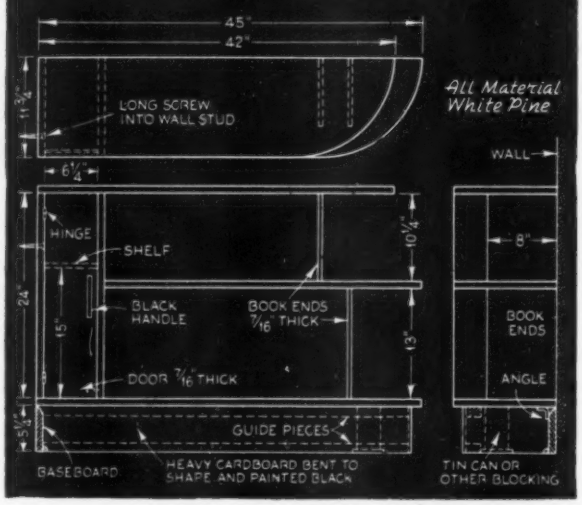
The sides of the motor well act as a brace for the inner transom shown in the left-hand drawing. The position of intermediate frames, used for calked-seam construction, can be seen in the second sketch

Modern Corner Bookcase OF SIMPLE CONSTRUCTION

OF CLEAN-CUT modern design, this bookcase will enhance the appearance of any living room. There are two bookshelves set at heights to accommodate practically all sizes of books. At the left is a compartment with a hinged door for cards, games, albums, and smokers' supplies.

The top of the bookcase will hold a small modern lamp and an electric clock. The wires of both may be easily concealed by running them close to the back of the case and down into the subbase, where a receptacle may be placed, if properly wired according to the regulations of the Electrical Code.

For greater ease of construction, the bookcase is built right up to the wall without any backboard, and the apron at the bottom is made of heavy cardboard so that it may be readily bent to the desired curve.—K. N. SWANSON.



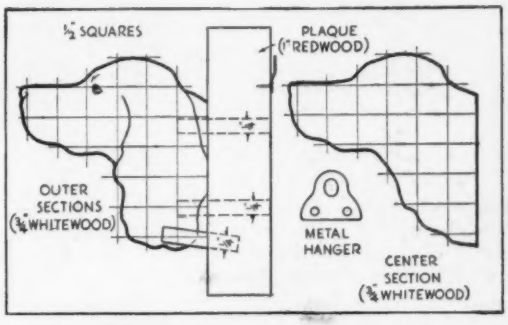
Front, top, and end views of the bookcase. The dimensions may be changed as necessary to suit individual requirements

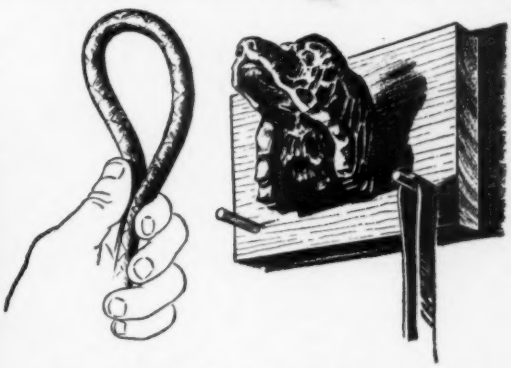
Motor from Discarded Phonograph Drives Small Disk Sander

FOR some model work, I required a small disk sander and hit upon the idea of using the motor from a discarded spring-driven phonograph. I removed it from the cabinet and mounted it in a wooden box 6″ wide and 12″ long. A hole was left in the top for the speed regulator, but all other attachments of the phonograph were removed, including the heavy center piece of the turntable. The rivet holes were used for screwing on a plywood sanding disk 4″ in diameter.—L. C. TAYLOR.

Reflectors Serve as Funnels

ON THE farm or around the shop, old auto headlight reflectors make serviceable substitutes for funnels. They are particularly useful for oil or other sticky liquids which have to be drawn from barrels and for which it is not desired to use a good funnel.—N.W.





Leash Holder Decorated with a Dog's Head

THIS decorative cocker-spaniel leash holder will remind you to hang up your dog leashes when not in use. The dog's head is jig-sawed in three sections from ¾″ whitewood. These are fastened together with casein glue and finished with motor-driven rotating rasps and wood files or with a pocketknife and hand files. Obtain the 3/16″ eyes from a taxidermist. The plaque is 1″ by 4½″ by 6″ redwood. Fasten the head to it with ¼″ dowels, and add two ¼″ dowels at an angle to hold the leashes. Color the head with black ink.—EDWARD B. FOX.

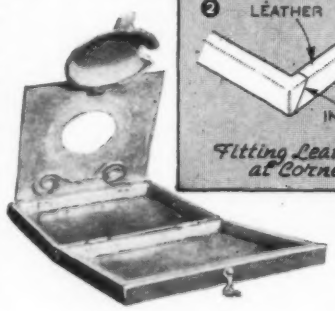
OLD WATCH BECOMES A Traveler's Clock

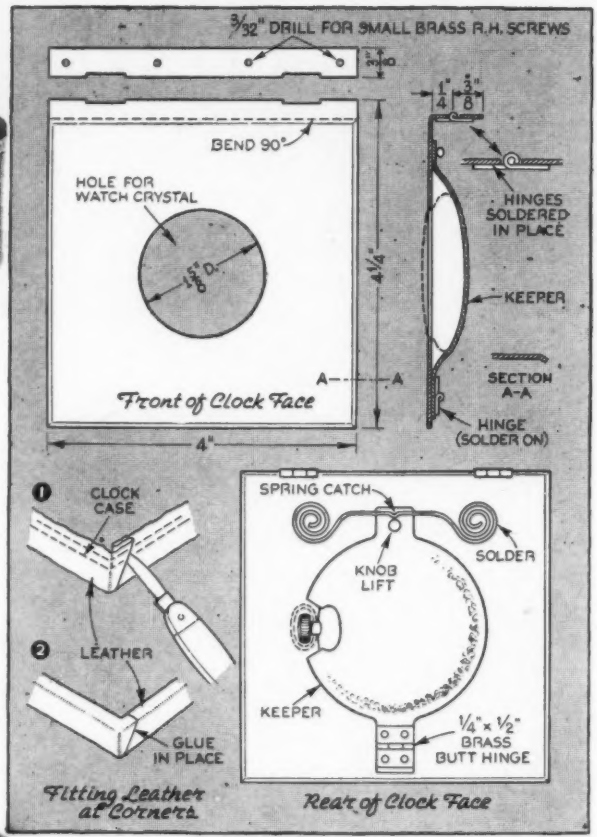
For traveling, the clock folds into a neat-looking, flat, leather-covered case

THAT outmoded watch, long tucked away in a dresser drawer, can be converted into a valuable traveler's clock by making a case for it like the one illustrated.

A suitable box—in this case 4⅛" square and ⅝" deep, inside measurements—is assembled from hardwood, sawed into two sections, and fitted with a pair of ¼" by ½" brass butt hinges, with enough clearance for the leather covering.

The leather is glued to the top and bottom outside surfaces and allowed to set before it is fitted at the corners and inside edges. No glue is applied at the locations of the hinges. The surplus leather is trimmed away, and a square of leather is cut and glued to each of the large inside surfaces. After the glue has set, the hinges are again fastened, flaps of leather being raised to admit them. A small brass hook is attached to fasten the case when folded.

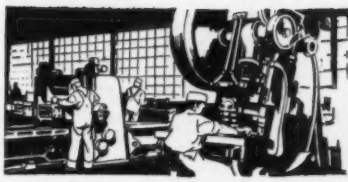




How the copper clock face and keeper are made and assembled, and method of fitting the leather. Left, the case open, ready to receive a watch

The wrought-copper face and keeper is trimmed to the size of the interior of the case, plus ¼" along one edge to fold down. Another copper strip ⅜" wide is fastened to this edge by soldering on two ¼" by ½" brass butt hinges. A circle the same size as the watch crystal is cut in the center, and the surface is hammer marked. The keeper, hinged to the back, is made by beating a piece of copper into the form of a cup to fit the watch, which is done on the end of a piece of hardwood held in a vise, and it is held closed by a catch made from brass spring wire.

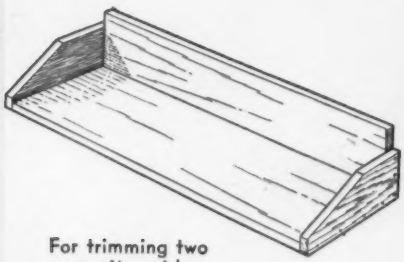
The copper parts are cleaned in a hydrochloric-acid bath, washed, and placed in a solution of liver of sulphur until very dark. The parts are then dried in a warm place, polished with flour of emery to bring out the high lights, and given a coat of floor wax. The leather case is finished by drawing lines along the edges, using a heated nut pick for a tool, after which the leather is waxed and polished.—CHARLES M. RICE.



NEW SHOP IDEAS

Rough Sawing, Resawing, and Ripping

BY HOWARD R. HEYDORF

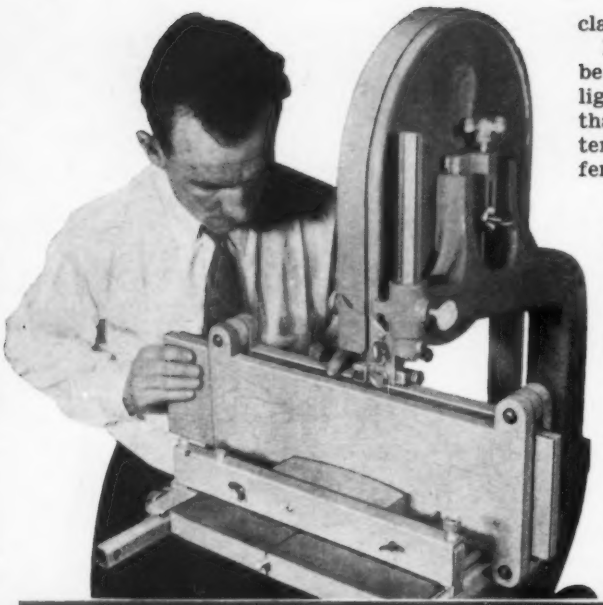


For trimming two opposite sides, rough pieces are held in a cradle

ROUGH sawing, resawing, and ripping are easily done on the type of band saw found in small shops and home workshops. The methods used in these three processes are similar and comparatively simple.

Quite often craftsmen have a chance to obtain a piece of high-grade wood in a rough or irregular form, such as a section or a crotch of a tree. From discarded furniture, the worker can frequently obtain turned legs and carved parts that can be cut up. Regardless of the nature of the wood, the method of bringing it to shape is the same.

A cradle is first constructed as shown. It consists of two boards fastened at right angles and braced with end pieces. The inside dimensions are governed by the size of the rough stock, which is fitted into the cradle and nailed securely. The cradle is placed against the rip fence of the band saw so one edge of the material may be trimmed, then turned for cutting the other exposed edge. The work is now removed from the cradle as the two cut sides make it a simple job to trim the rest of the block. If the saw is not equipped with a standard rip fence, a guide fence or strip may be securely

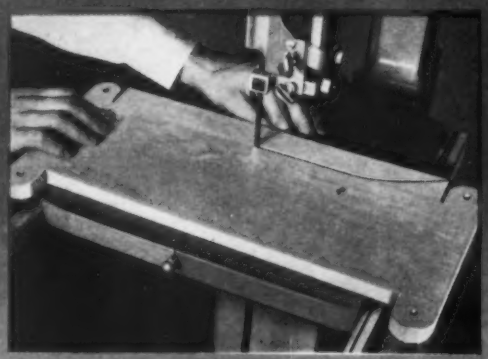


clamped to the saw table as a substitute.

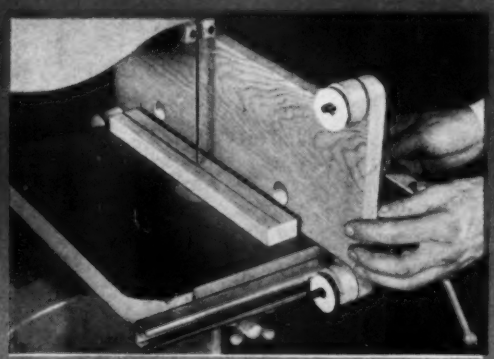
Boards that have irregular edges may be quickly trimmed if a straight strip is lightly nailed to the top in a position so that its edge extends over that of the material. This strip passes along the rip fence and guides the material.

Under normal conditions, when a piece of wood is pushed into the band-saw blade, it would be cut in a straight line. Often, however, the saw will pull or lead to one side. When the guides are correctly adjusted, this fault, if slight, may be remedied by lightly honing the leading side of the blade as shown with a fine oilstone. However, because of the difficulty of honing a blade accurately, it is simpler to adjust the ripping fence or guide strip at the needed angle to correct the lead.

The craftsman often requires thin boards for special purposes. These may



Cutting a sidepiece for the jig. In this type of ripping, the fingers of one hand serve as a pivot



The test strip is moved until the blade cuts in a straight line, then the fence is adjusted to suit

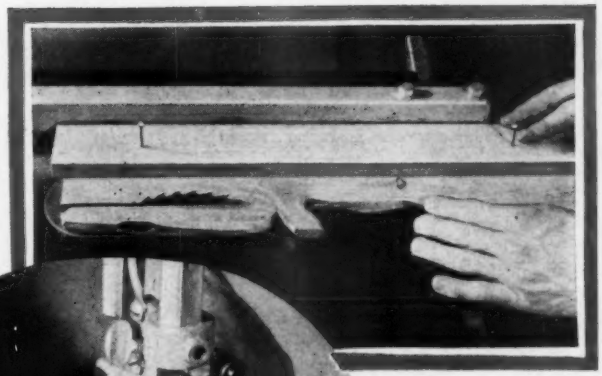
If a curved part is of uniform width, the second cut is made by clamping a pivot opposite the blade

Strips are cut to a uniform arc by using the ripping fence, which is marked at the pivoting point

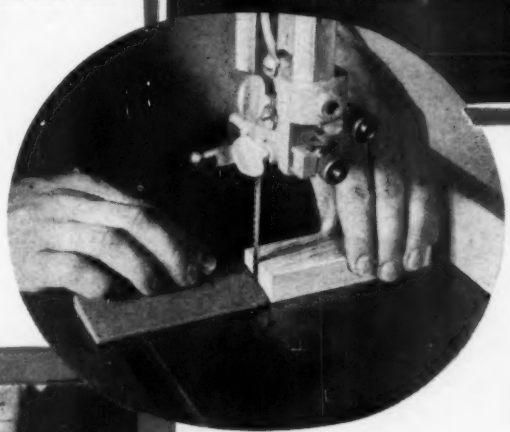
be easily cut on the band saw. There are a number of ways to do this resawing. Where the band-saw blade shows a tendency to lead to one side, the pivot style of fence may be used to great advantage. This is cut to the shape shown and has the working edge slightly rounded. The material is held firmly against the end of this fence as it is fed into the saw, and the end of the work is swung as needed to insure a straight cut. Where the leading tendencies of the saw are slight, the edges of the stock may first be grooved on the circular saw, and the regular band-saw ripping fence used to guide the work.

If much resawing is done, the jig illustrated will aid in doing the work quickly and accurately. It is constructed to fit the band saw. The guide fences are shaped from ¾" wood. The projections are about ¾" in radius and are drilled for 5/16" carriage bolts. Spacers are cut from wood of the same thickness as the material to be resawed. One of these and a disk of thin cardboard are placed on each bolt between the fences. To permit the fence to be adjusted for the leading tendencies of the blade, the jig is fitted with a "rocker." The edge of a 2" block is cut on a slight curve, and the block is fastened to the ripping fence as shown so that its center is in line with the teeth of the saw blade. Two ¼" carriage bolts pass through the wooden fence and the ripping fence and are held with wing nuts. A strip of wood is passed into the saw blade, and the wooden fence is adjusted to the correct angle needed to make the blade cut in a straight line. This is done by loosening one wing nut and tightening the other. The ripping fence adjusts the jig for the thickness of the material to be cut. The material is cut by passing it between the two fences as shown.

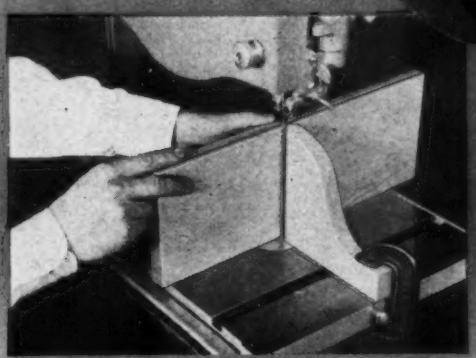
When work is being ripped on the band saw, the pivot style of guide fence is used in much the same manner. If a number of curved pieces of uniform width are required, they may be shaped by first cutting one side. A pivot piece is then clamped the required distance from the saw blade, and the other side is shaped. To cut uniform arcs, the ripping fence alone will serve as a pivot if a mark is placed on it opposite the saw teeth.



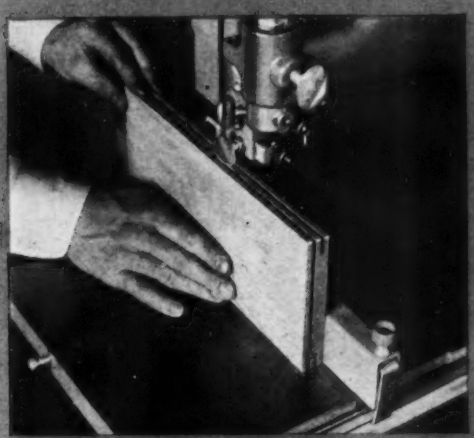
A strip nailed to a board with irregular edges enables it to be guided properly past a circular saw



The leading side of a band-saw blade may be honed very lightly with a fine oilstone



Resawing with aid of a pivot fence. The end of the work is swung as necessary for a straight cut



The regular fence serves for resawing if the edges of the board are first grooved on a circular saw

Sliding V-Block

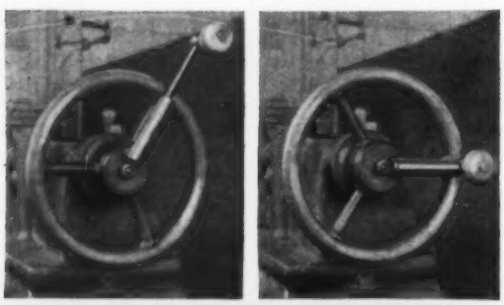
REDUCES BREAKAGE OF DRILLS

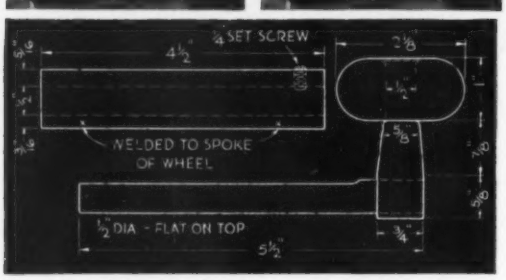
This V-block consists of two stationary end blocks and a movable block that slides on a guide rod between them

A THREE-PIECE V-block of the type shown, in which the center block slides on a guide rod between the two end blocks, is better than a plain V-block for all-around use. Work having shoulders may be held so that there is no danger that the point of the drill will strike the clearance groove in the bottom of the block. When this happens and the drill, as often is the case, is larger in diameter than the groove, it is likely to break, especially if the block happens to be of tool steel and hardened. In making this jig, be certain to drill the holes accurately for the guide rod so that the three blocks will be in alignment.—CARL VON MOLTKE.

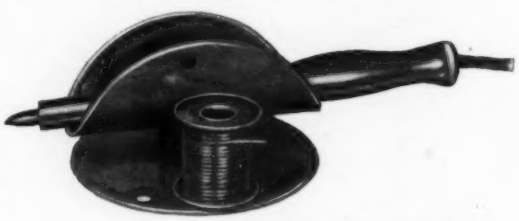
Lathe Tailstock Handle

FOR heavy drilling in the lathe, additional leverage may be obtained by attaching a telescoping handle to the tailstock wheel as illustrated below. In this particular installation it has been found that the extended handle gives sufficient leverage to push a 2″ drill through work held in the chuck.—G.S.W.





How the telescoping handle is made and, above, two views showing it in the extended and normal positions

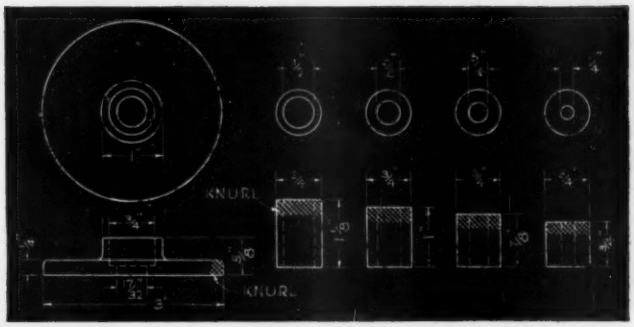


Large Metal Spool Holds a Soldering Outfit

A LARGE, empty metal spool with the sides bent up as indicated will serve as a soldering-iron holder. This particular spool was one on which lamp cord had been wound. The wire solder is kept in place by a 1½″ long 6-32 bolt extending up through the bottom; and two small brass clips or ½″ bolts hold the paste tin on the other side. There is sufficient radiation from the metal so that the holder is always cool enough to carry from job to job.—R. B. WALKER.

Welding Electrodes Cut Steel

ARC-WELDING electrodes may be used in place of carbons when cutting steel, cast iron, and other metals. Higher current settings, longer arc lengths, and reverse polarity are usually necessary. A welder's trick is to soak the electrodes in water for a few minutes before cutting because this slows up the burn-off rate. This is said to be because the hydrogen reaction is increased.—LESTER J. KING.



Hand Taps Started Straight with Aid of a Guide

HAND taps can be started vertically in a flat surface with less difficulty if a guide is used. The one illustrated will hold the tap in the correct position until it has entered far enough to insure accuracy. The base, in which a bushing of the proper size is inserted, is held down firmly with one hand while the tap is started with the other. The guide shown has bushings for ½", ⅜", 5/16", and ¼" taps, but other sizes may be added. The bushings are a close fit in the base and are knurled at the top as indicated for a better grip when necessary to change from one size to another.—H.T.

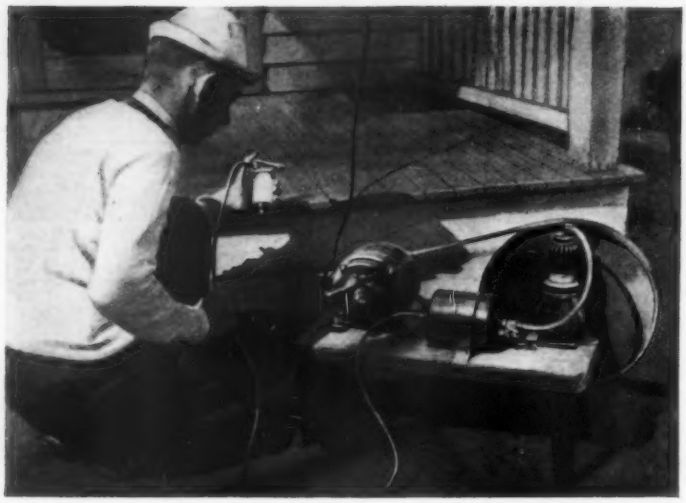
Old Piston Serves as a Soft Anvil for Supporting Polished Work

AT ANY repair bench where work has to be done on finished metal parts, it is desirable to have a small anvil with a soft metal surface. This is used for backing up highly polished or plated work without danger of marring it. An old aluminum-alloy piston, clamped to the bench top by means of a hook bolt over the piston pin, forms a good anvil of this type. When the surface becomes cut and battered, a file quickly restores it; or if it is too badly scarred, another piston can be easily substituted. This anvil, in fact, is less trouble to make than the usual form, which is an iron ring with a poured lead center.—W.C.W.

Height of Trammel Points Adjusted with a Level

IF A MACHINIST'S trammel is used for laying out the distance between two points lying in different planes, a small level will save some figuring and insure accuracy. Obviously, if the required distance were taken from the scale and transferred to the work with no regard for the height of the two points, the measurement would be too short. A level is especially valuable in a case such as illustrated, where it would be next to impossible to make the measurement on the edge and square lines across. If a number of measurements are to be made, the level can be held in place with wire.—S. J. GANCHER.

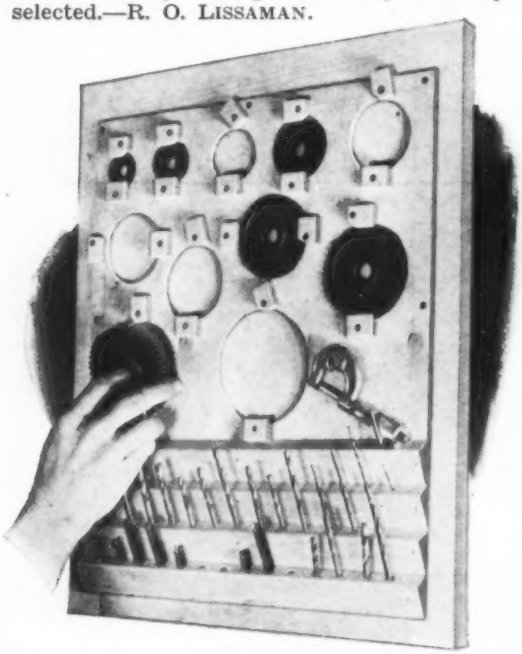
Oil Filter Cleans Air for Paint Spraying

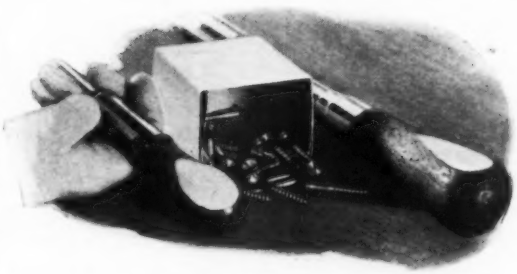


A NEW oil filter, which cost less than a dollar at an auto store, serves as the pulsation chamber and air cleaner for the homemade paint-spraying outfit illustrated. The filter is easy to install, but care must be taken to use the end marked "inlet" for the line from the pump, because it is possible to connect most filters so that the air will not pass through the filtering medium. When this cleaner is used, oil can be applied freely to the pump—in this case an old auto tire pump—to obtain maximum pressure and long life, yet none of it will pass the filter.—NATHAN GARDINER.

A Rack for Change Gears

LATHE change gears may be kept instantly available by making a cut-out panel as shown below to fit the inside of a tool-cabinet door. Recesses are cut to fit the various gears, which are held in place with turn buttons. In this case the lower part of the door carries an additional rack arranged in steps for holding drills and cutting tools in such a way the right one may be easily selected.—R. O. LISSAMAN.





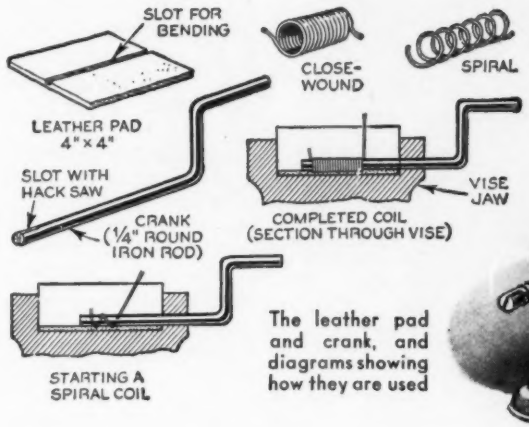
Tool Handles Flattened to Prevent Rolling

ROUND-HANDLED tools such as screw drivers and small chisels have an annoying habit of rolling just out of reach after they have been laid down. This may be prevented by dressing a flat face on opposite sides of each handle. It will be found that the flat surfaces also afford a better grip on the tool.

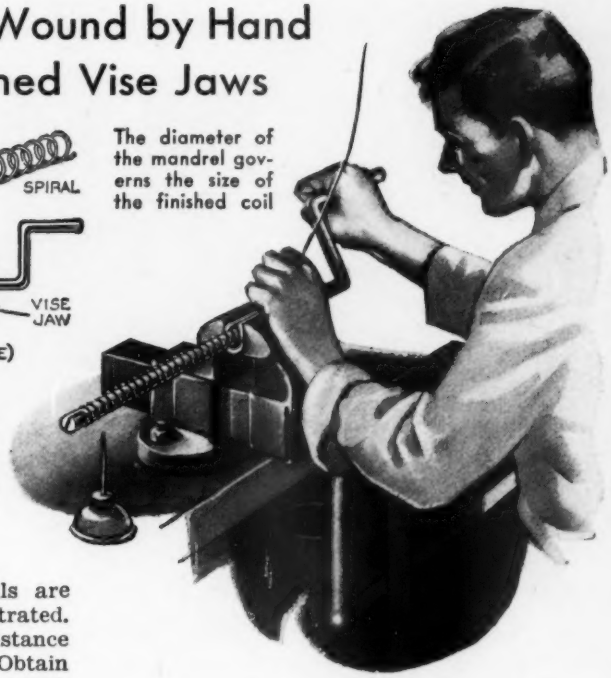
Starting a Tap in a Corner or on Irregular Surfaces

IN TAPPING holes on very irregular surfaces or in corners, it is difficult to start the tap squarely. A good way to accomplish this is to withdraw the drill from the chuck of the drill press, replace it with the tap, and turn the spindle by hand until the tap has been started into the hole. After the first few threads, the tap can be removed from the drill chuck and the tapping finished by the usual method.—EVERETT W. CLEM.

Coil Springs Quickly Wound by Hand Between Leather-Lined Vise Jaws



The leather pad and crank, and diagrams showing how they are used



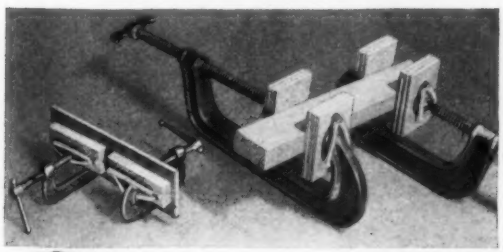
The diameter of the mandrel governs the size of the finished coil

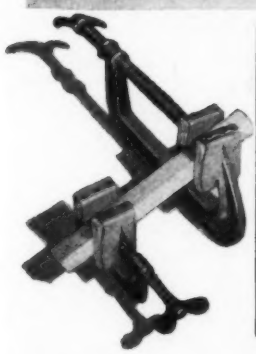
COIL springs and other wire coils are easily wound by the method illustrated. Suppose, for example, a coil of resistance wire has to be wound for a toaster. Obtain a piece of ¼" round iron rod, slot one end, and bend as shown. Make a leather pad and, if stiff, cut a slot through the center. Place the winder, leather, and end of the wire in the vise as indicated, and turn the crank until the coil is completed. Keep the vice jaws tight.

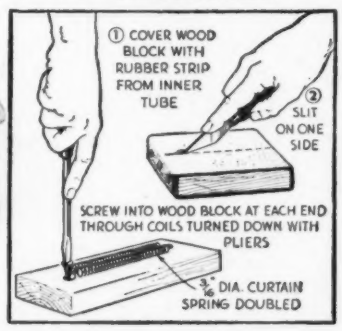
If a spiral coil is required, start the wire at an angle. Do not have the vise jaws too tight until a few turns have been made. The wire will form a track in the leather so the rod will move at a uniform rate and feed the wire as evenly as if done with a machine.

For larger coils, a bolt may be used in place of the crank, and a wrench used to turn it. The threaded end, however, will have to be cut off before the bolt is slotted to take the wire. Oil the leather, if necessary, to make the turning easier. For springs it is essential, of course, to use spring wire such as music or piano wire.—EDMUND C. HANLEY.

Attaching Glue Blocks to Jaws of Clamps



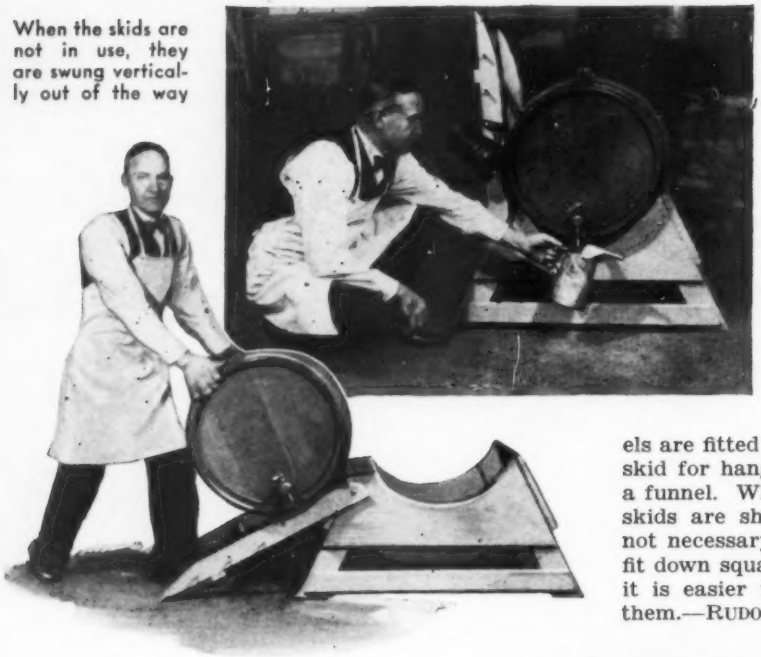



① COVER WOOD BLOCK WITH RUBBER STRIP FROM INNER TUBE
② SLIT ON ONE SIDE
SCREW INTO WOOD BLOCK AT EACH END THROUGH COILS TURNED DOWN WITH PLIERS
⅜" DIA. CURTAIN SPRING DOUBLED

GLUING up pieces of furniture or other woodwork is often a two-man job because of the difficulty of tightening the clamps and at the same time keeping in place the blocks or scrap pieces of wood used to prevent the jaws from marring the work. This can be remedied if a method is devised to keep the blocks in place. Two ways are suggested. In one case, each block is held by a rubber strip from an inner tube; in the other, by small diameter coil springs such as those sold for hanging window curtains. The coil-spring method works better on very small clamps, but it may be necessary to grind a small notch to keep the spring from slipping off. The rubber-covered blocks have the advantage of providing an extra soft contact surface.

Convenient Barrel Stand Has Skids Attached

When the skids are not in use, they are swung vertically out of the way



BARREL stands made like the one illustrated are an aid in handling bulk liquids in stores, large kitchens, factories, and elsewhere. The legs are 2″ by 4″, the cradles are sawed from a 1″ by 12″ board, the braces are 1″ by 3″, and the skids are also 1″ by 3″. When a barrel has been rolled up the skids onto the stand, the skids are turned up vertically, out of the way. Dowels are fitted into the face of the front skid for hanging liquid measures and a funnel. While the lower ends of the skids are shown rounded off, this is not necessary. I now cut the ends to fit down squarely against the floor, as it is easier to roll the barrel up on them.—RUDOLPH KNAUS, SR.

Fastening a Fence Wire So It Can Be Let Down

WHERE access is necessary to a fenced-in field yet it is inconvenient to install a gate, a wire may be fastened so that it can be let down easily. Drive two long staples into the post so that the wire will slip between them, and push a nail through the staples to hold the wire. To let down the wire, simply remove the nail with pliers.—NORVAL WRIGHT.

Metallic Paper Insulates Inner-Spring Mattress

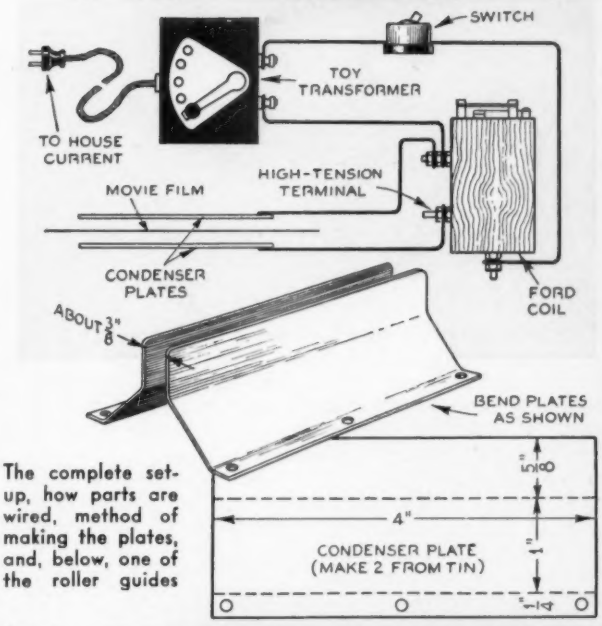
PERSONS who like to sleep with the bedroom windows open in the winter often find that the cold air filters up through the inner-spring mattress and cools the sheets. This can be prevented by placing a piece of foil-covered insulating paper between the springs and the mattress. This not only prevents the infiltration of cold air, but reflects body heat up to the sleeper. Covering the screened ventilating holes of the mattress with adhesive tape also helps to keep the cold air out.—L. F. TRIGGS.

Cleaning MOVIE FILMS WITH Electricity

DUST and particles of foreign matter that adhere to home movie film and cause specks and streaks on the screen may be removed from ordinary black-and-white film with damp cotton or various cleaners, but it is risky to use this method for cleaning color film. A much better and safer method is to make the simple electrical set-up illustrated. This costs less than the price of a good solvent cleaning kit.

Two condenser plates are cut from a piece of tin can and mounted as shown. These are energized by means of a spark coil. An old model-T Ford vibrator coil is just the thing, and it can be operated by a storage battery, dry cells, or bell-ringing transformer. The condenser plates, which are connected as shown in the diagram, should be set as close together as practical without being so close that the spark will jump between them.

The film is threaded through the cleaner by means of two guides, the current turned on, and the film pulled slowly between the plates. The rapid reversal of the electric charge causes the particles, which are held to the film by an electrostatic charge, to be released. If a piece of white paper is placed under the cleaner, you will be surprised at the miscellaneous assortment of particles removed from the film.



The complete set-up, how parts are wired, method of making the plates, and, below, one of the roller guides

BY W. C. CHENEY

Miniature Camera Mounted on Flexible Lamp Stand

The camera is held on the end of the stand by a cut-off carriage bolt and a set screw

SCREW NUT ON TIGHT AND SOLDER WASHER AND NUT TO BOLT
REMOVE
SOLDER HALF WASHER IN SLOT
CARRIAGE BOLT (8-32 THREAD)
8-32 BOLT
Adapter to Hold Camera
Set Screw

WHEN a low camera position is needed, as in a table-top or nature photography, and the ordinary tripod is too awkward, a desk lamp of the adjustable shaft type may readily be adapted for the purpose. Unscrew the light socket with attached reflector from the shaft and pull out the wires. One end of a bolt, altered as shown, screws into the tripod socket on the camera, and the other fits in the lamp stand. A hole drilled through the shaft and tapped to take a No. 8-32 screw holds this adapter firmly. When the lamp stand is no longer needed as a camera support, the wires and socket are easily replaced.—C. ELMER BLACK.

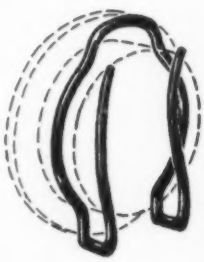
Legibly Marked Graduate

ON INEXPENSIVE, pressed-glass graduates, the ounce markings are often so faint as to be practically invisible in the dim light. They can be easily read, however, if gone over with a durable black paint or varnish. Asphalt varnish is particularly suitable because it is not affected by developing solutions.

Holder for Filters Bent from Copper Wire

COPPER wire bent as shown in the accompanying sketch makes an efficient filter holder for a camera. The loop that keeps the holder in place is shaped slightly smaller than the diameter of the lens mount so the tension will hold it firmly.

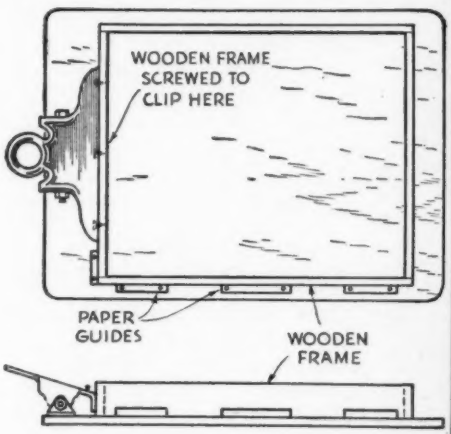
Although this holder was designed primarily for gelatin filters mounted between pieces of cardboard such as amateurs often use, it is equally valuable for unmounted glass filters, and it will serve with a combination of three filters mounted between cardboard to slide horizontally in front of the camera lens for use in natural-color work.



Copper wire is bent to fit snugly over the lens mount, and the ends are turned up to hold filters, inserted as at right

Enlarging-Paper Holder

MADE FROM A FLAT SPRING-CLIP LETTER FILE

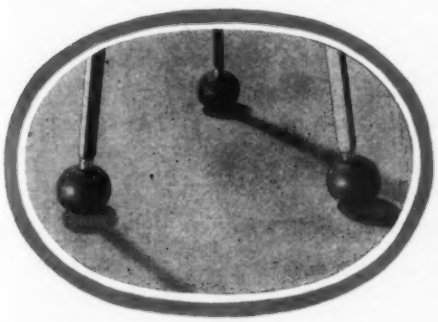


Slipping the paper between the wooden frame and the face of the file. Note guide blocks. Right, a simpler holder

AN INEXPENSIVE hanging file of the type illustrated, which may be obtained at almost any stationery store, can be converted into an efficient paper holder for enlarging. All that is necessary is to screw two spring clips to the bottom of the board as shown in the smaller photo.

If white borders are desired, make a frame from ¼" by 1" strips of wood, the outside dimensions being the same as the largest projection paper to be used, and reënforce the corners with angle irons on the outside. Screw the frame to the metal clip of the hanging file so that it will lift up when the clip is pressed, enabling the paper to be slipped underneath. Four strips of wood nailed to the base of the file just outside the frame area will serve as guides for centering the paper. The frame should be painted dull black, and the base of the file white.

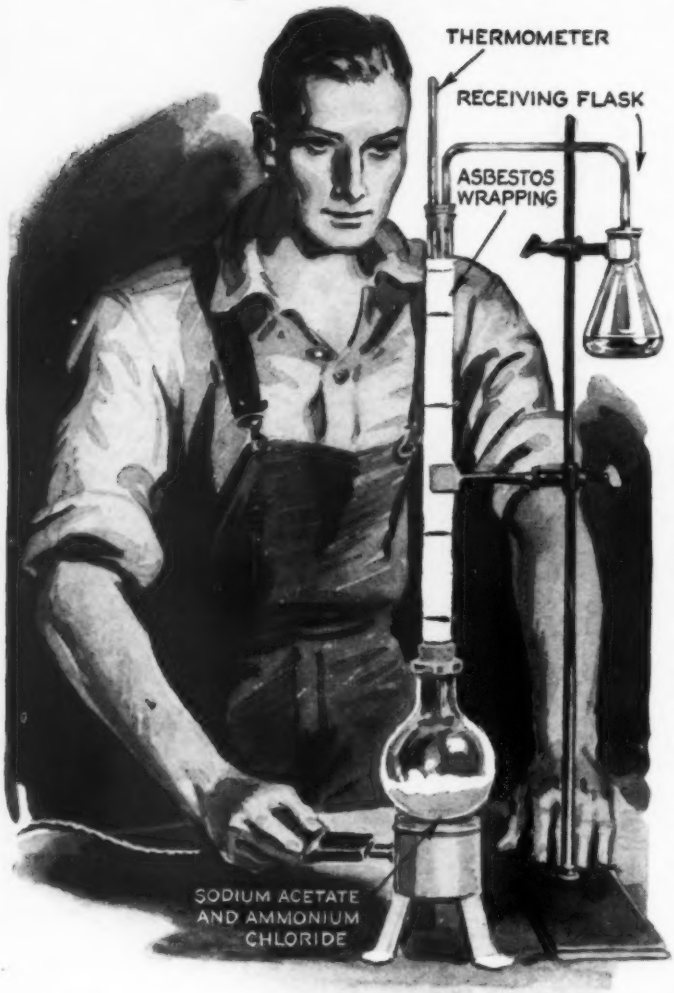
To adapt the holder for enlargements of a smaller size, make cardboard masks like shallow boxes to fit over the bottom of the frame, and cut rectangular holes out of the corners nearest the paper guides.—L.H.



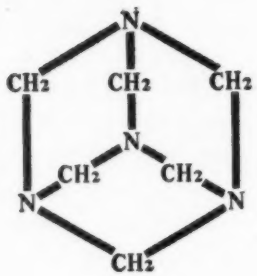
Small Sponge-Rubber Balls Form Nonskid Feet for Tripod

OF ALL the nonskid tripod feet the writer has seen in use by amateur photographers or has tried himself, the most efficient are made by drilling holes in ordinary sponge-rubber balls to fit over the ends of the tripod legs. Not only do these feet prevent slipping on polished floors, but they also keep the legs from sinking into soft or sandy soil.—H.R.H.

Try Your Hand at



Making acetamide. Crystals of sodium acetate and ammonium chloride are melted in the lower flask, and the chemicals undergo a series of reactions to produce acetamide, water, and common salt



How hexamethylene tetramine is written in chemists' shorthand

EVEN if you have already explored every bypath of inorganic chemistry, your adventures with test tubes and Bunsen burners have scarcely begun. The whole realm of organic chemistry lies ahead of you—with ten new chemicals for every one that you have used before!

While inorganic chemistry deals with mineral substances, organic chemistry includes all the infinitely more varied products of plant and animal life. Today it also takes in many synthetic compounds that can be found nowhere in nature. The best definition of organic chemistry, therefore, is "the chemistry of the compounds of carbon"—omitting the oxides of carbon, the carbonates, the acetates, and the carbides, which usually are classed as "inorganic." Only some 25,000 inorganic compounds are known to chemists, but the number of organic compounds discovered to date has probably reached a full quarter million.

Suppose you pick a few at random—acetamide, salicylic acid, and hexamethylene tetramine. Don't be scared off by a high-powered name like this last one. The compounds just mentioned are easy to make and experiment with, and will give you something new and interesting to try in your home laboratory.

To make acetamide, mix about 100 grams (three and a half ounces) of sodium acetate crystals with an equal weight of ammonium chloride crystals. Place the mixture in a flask, to which is attached a vertical glass tube about an inch in diameter and two feet in length, wrapped in pipe covering or several layers of asbestos paper for heat insulation. Fit the top of this tube with a two-hole stopper carrying a thermometer and an outlet of glass tubing, which leads to a receiving flask.

Now start heating the flask. Soon its contents will melt. Continue heating slowly, so that the temperature at the top of the vertical tube remains in the neighborhood of 110

Organic Chemistry

With Ten Brand-New Chemicals for Every One You Knew Before, This Vast New Field of Research Holds Many Thrills for Amateurs

By
RAYMOND B. WAILES

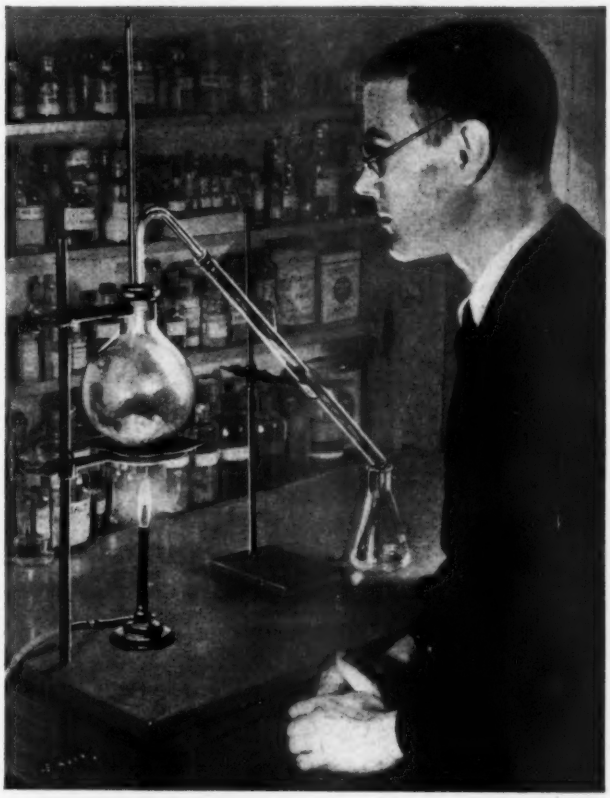
• •

degrees centigrade (230 degrees Fahrenheit), for fifteen or twenty minutes. The chemicals in the flask will interact and form ammonium acetate and sodium chloride, or ordinary salt. The ammonium acetate, in turn, is decomposed by the heat into the acetamide and water. This water collects in the receiving flask, while the acetamide remains in the lower flask with the salt after the heating. The vertical tube supplements the space that the flask provides for the reaction, and also serves the purpose of a "reflux condenser," which prevents the escape of volatile products from a flask by condensing and returning them.

The next step is to separate the acetamide from the residue in the flask, and this can easily be done by distilling it off and collecting it. For this purpose, disconnect the upright glass tube from the flask and substitute a length of glass tubing that leads downward at a forty-five-degree slant to an empty collecting flask. The slanting tube forms an air-cooled condenser, which is preferred for distilling substances of high boiling point that would solidify and clog an ordinary water-cooled condenser. It may be of two-foot length and of any diameter from half an inch to an inch; the tube previously used as a reflux condenser will serve, if you remove the heat-insulating material around it. The connection with the flask holding the acetamide should provide for inserting a thermometer, with the bulb just below the cork.

Now heat the flask until the thermometer reads 250 degrees centigrade (or about 480 degrees Fahrenheit). The acetamide will distill over into the collecting flask. Some acetamide will also crystallize in the condenser, as your distillation proceeds, but you can melt it and send it on its way by waving a flame across the tube. If the preliminary "refluxing" operation has removed most of the water, as it should, the final product in the collecting flask will be a white crystalline solid. Since acetamide avidly collects moisture from the air, it must be kept in a tightly stoppered bottle. To show this water-absorbing or "deliquescent" nature of your homemade organic chemical, expose a few crystals of acetamide to the air. In only a few hours, they will collect enough moisture to dissolve in it and form a clear solution.

Place several grams of acetamide on a sheet of glass, melt it with a small flame ap-



Air-cooled condenser being used to separate the acetamide from the salt. For some operations, a condenser of this type is more satisfactory than the water-cooled variety

By breaking down artificial oil of wintergreen, you can get a supply of salicylic acid crystals

plied beneath the glass, and then allow it to cool. In about a quarter of a minute, a beautiful crystalline growth will appear. You can start it at any place you want, simply by touching the molten film of acetamide with a sliver of wood.

Now for the most remarkable property of acetamide. Quite recently, chemical experiments have established that more different chemicals will dissolve in it than in any other known solvent. According to Prof. O. F. Stafford, of the University of Oregon, it represents the nearest approach so far discovered to the fabled "alkahest" or universal solvent sought by the alchemists of old. Because of the importance of solvents in medicine and industry, new vistas may be opened by its use. You can verify for yourself how readily a comparatively insoluble chemical like mercuric oxide (red oxide of mercury) can be dissolved in heated acetamide.

Even simpler to make than acetamide is the compound with the formidable name of hexamethylene tetramine. All you need do is mix about thirty cubic centimeters (or one fluid ounce) of strong ammonium hydroxide solution with an equal volume of formaldehyde solution, and heat the mixture for about an hour on a water bath. This may be improvised by placing a porcelain evaporating dish, containing the liquids, on top of a beaker in which water is kept boiling with a Bunsen flame. The heat drives off water from the reacting chemicals, and the remaining white crystals of hexamethylene tetramine may be scraped from the dish and preserved in a cork-stoppered bottle.

BEAUTIFULLY colored precipitates are formed, in many cases, when a solution made from these crystals is added to solutions of inorganic chemicals. Try its effect upon any of the metallic salts on your shelf, and also upon some tincture of iodine that you have diluted with water. You will find, for example, that hexamethylene tetramine yields blue precipitates with hot solutions of copper chloride, copper nitrate, and copper sulphate. Yellow precipitates are formed with uranium salts, and a brown precipitate with the diluted iodine. A hot, saturated solution of calcium chloride gives a white precipitate, as do solutions of magnesium chloride and mercuric chloride. These "addition compounds," as chemists call the products, go by such long names as calcium chloride hexamethylene tetramine. The precipitate obtained with magnesium chloride is an antiseptic.

Hexamethylene tetramine itself finds use as a medicinal drug, under the name of urotropin, which you may prefer to call it for short. It also is employed in certain types of gas masks, where its eagerness to combine with many toxic gases to form harmless compounds makes it of considerable value

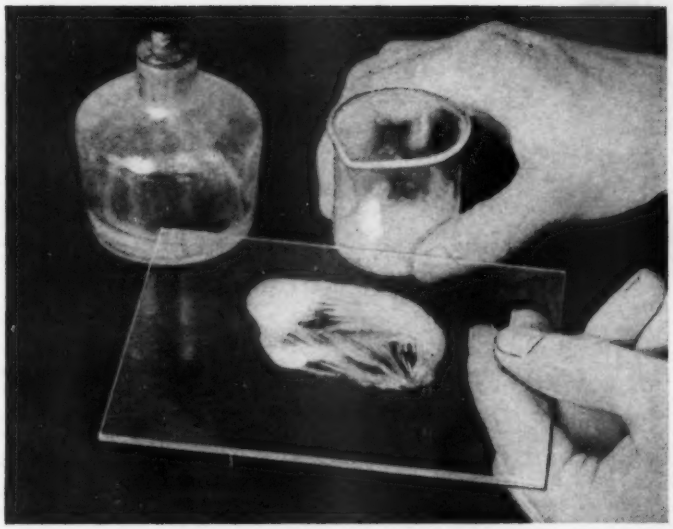
SIMPLE WATER BATH. The set-up at the right is used in making urotropin, or hexamethylene tetramine, from ammonium hydroxide and formaldehyde

as a protective material.

You can make one type of synthetic plastic from your crystals of hexamethylene tetramine by heating a gram or so of them, in a test tube, with an equal volume of phenol crystals. A hard, transparent yellow resin will be formed.

Your local druggist stocks hexamethylene tetramine, or urotropin, so you can obtain it ready-made for your experiments if you prefer. The drug store will also supply you with another interesting organic chemical to experiment with—artificial oil of wintergreen, or methyl salicylate.

Used externally as a liniment for rheumatic aches and pains, methyl salicylate is manufactured by heating wood alcohol with salicylic acid and a small amount of sulphuric acid. You can readily tear it apart again in your laboratory, and regain salicylic acid from it.



Beautiful fernlike crystals of acetamide form before your eyes when the chemical is heated on a glass plate and allowed to cool

Dissolve about ten grams of sodium hydroxide (two teaspoonfuls), or ordinary lye, in 100 cubic centimeters (about three and a half fluid ounces) of water. Let the solution cool, place it in a flask, and add to it ten cubic centimeters of the artificial oil of wintergreen. Heat the mixture until the oily methyl salicylate disappears, which will take about fifteen minutes. To prevent the escape of the volatile oil from the flask, so that all of it will react with the alkali, the flask may be fitted with an air-cooled reflux condenser by mounting vertically, above it, a two-foot glass tube of at least half-inch diameter. Oil condensing on the inner walls of this tube will then drip back into the flask.

WHEN the oil has vanished, due to its reaction with the sodium hydroxide, remove the flask from the source of heat and cool its contents by running tap water over it. Then pour some strong hydrochloric acid into the flask, shake it, and cool it again. A white, needlelike precipitate of salicylic acid will be thrown down. Repeat the operation until adding more acid produces no precipitate.

Now collect the precipitated salicylic acid by pouring the contents of the flask through a filter. Wash the crystals with several applications of cold water, while they are on the filter paper, to remove the hydrochloric acid. Then place a clean beaker beneath the filtering funnel, punch a hole through the filter paper with a pointed glass rod, and pour on boiling-hot water. This will dissolve the crystals and wash them into the beaker. When the solution in the beaker cools, they will crystallize out again, and may then be placed on paper, dried, and bottled.

Salicylic acid is used for preserving food, and for preparing dyes. To observe one of its interesting color reactions, add a drop or two of ferric (iron) chloride to a solution of salicylic acid, which will yield a violet-colored product. Derivatives of salicylic acid serve a wide variety of important uses—some as perfumes, and *(Continued on page 252)*

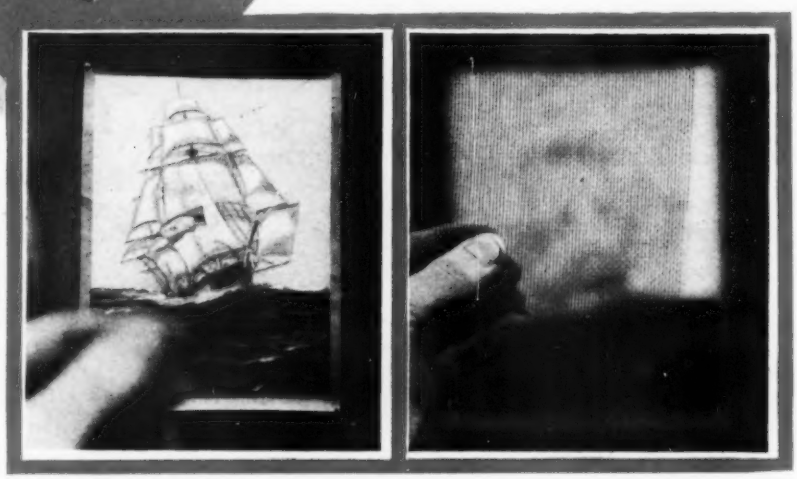
This simple test tells whether two white powders are the same organic chemical. Tiny piles of the powders are heated to determine their melting points

Laws of Science

Your Eye Is Focused Like a Camera

THE world's first camera was the eye. You can show by an easy experiment that your eye, like a camera, focuses on near or distant objects but not on both at the same time. Hold a square of wire screen about ten inches from your eyes. Concentrating on the screen, you see it distinctly; but a picture across the room behind it is blurred. Then concentrate on the picture, and the screen appears blurred.

Looking through wire screen at some object beyond, you can focus your eyes on either the one or the other



In the photographs at the right, the camera has duplicated the focusing action of the human eye. In one the screen shows clearly, in the other a picture

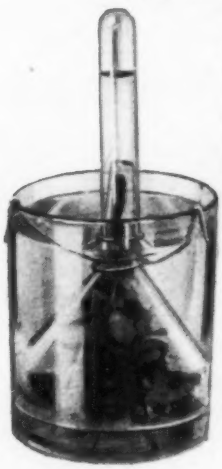
Gyroscope Resists Magnet's Pull

SPINNING gyroscopes resist any force which tends to upset their balance. You can demonstrate this in a curious experiment, using a small bar magnet and a homemade gyro-car, which is constructed from a toy gyroscope as shown in the photograph, with a bent iron wire extending from the top. Set the gyroscope in motion and then move the magnet near the wire. Instead of moving toward the magnet, the iron wire mysteriously moves away from it. Each time the magnet comes close, the same puzzling thing takes place. The explanation is that the magnet is really attracting the wire, but the gyroscope is counteracting the pull by moving in the opposite direction.

Proved in Easy Tests

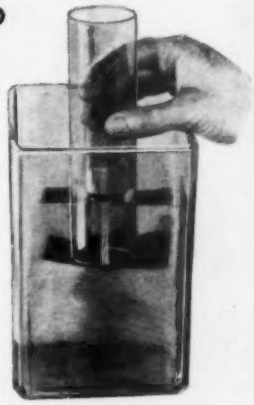
With a piece of ordinary window screening, a toy gyroscope, some glass tubing, and a few other odds and ends, you can perform five interesting tests that will prove nature's rules

Test Proves That Plants Give Off Oxygen



TO PROVE that plants liberate oxygen, suspend a glass funnel in a jar of water, inverted above some growing water plants. Then, fill a test tube with water and invert it over the end of the funnel. After several days, the tube will be filled with gas. If you thrust a smoldering stick into the tube after it has been removed from the water, the wood will burst into flame, proving the gas you have collected is oxygen.

Liquid Exerts Pressure Upward, Too

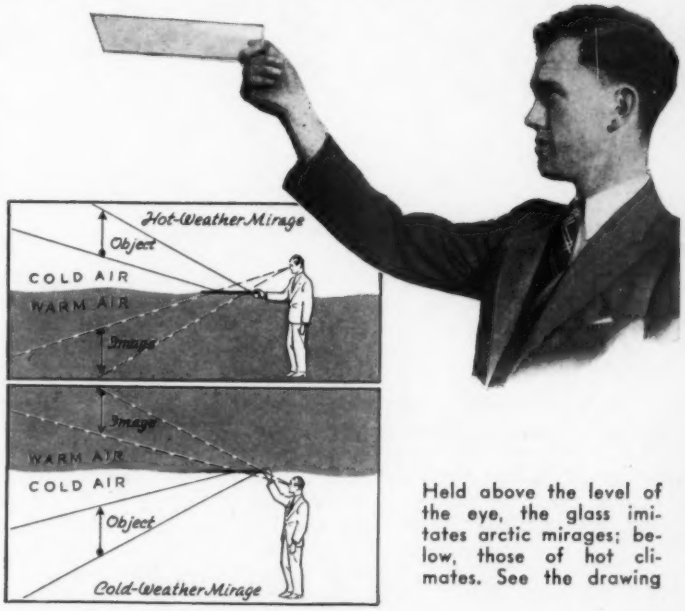


A piece of leather is held against the bottom of the tube by the water's upward push

WHEN you fill a jar with water, the fluid exerts pressure in all directions, upward as well as downward and to the sides. A glass tube, open at both ends, and a small square of leather will enable you to demonstrate this fact in a simple test. Submerge the end of the tube in the water after the leather has been placed over the opening, and hold it an inch or two beneath the surface. The leather, instead of dropping to the bottom of the jar because its weight is greater than the water's, will remain in position against the tube, thus demonstrating that the water in the container has an upward pressure.

Piece of Glass Explains Mystery of Mirages

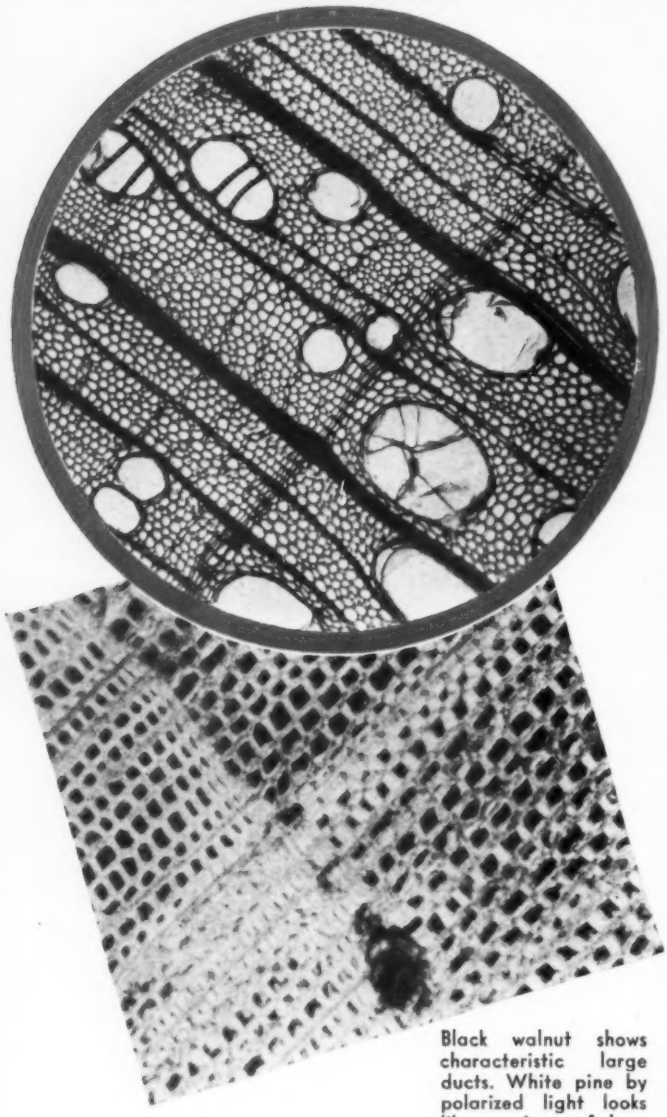
WHY DESERT mirages show pools of water on the sand, and polar mirages show ships and icebergs in the sky, can be demonstrated easily with a piece of window glass. Hold the glass in front of you, a little below the level of your eyes, and imagine it represents the dividing line between a layer of warm, rarefied air near the ground and colder, denser air directly above it. The sky will be mirrored in the glass, reproducing the illusion that occurs in hot-weather mirages. Then, hold the glass above eye level and imagine it is the dividing line between cold, dense air below, and warm, rarefied air above. You will see objects seemingly projected on the sky, as in a cold-weather mirage.



Held above the level of the eye, the glass imitates arctic mirages; below, those of hot climates. See the drawing

What Kind of Wood Is It?

. . . YOUR MICROSCOPE WILL TELL YOU



Black walnut shows characteristic large ducts. White pine by polarized light looks like a piece of lace

There's No Guesswork About Identifying Wood When You Employ Your Magic Lenses To Reveal the Beautiful Patterns of Its Cell Structure

By MORTON C. WALLING

CAN you tell a piece of genuine walnut furniture from one made out of gum wood that has been skillfully colored to resemble it? If you are the owner of a microscope, and have looked at some of the wonders under the bark of a tree, the chances are that you can. For an examination of the microstructure of wood shows you very clearly why walnut is walnut, and why red gum is not; and it introduces you, too, to a great many other interesting things. Wood, so easily obtained and prepared for examination, is one of the most entertaining subjects for microscopic study.

Before discovering the surest way of identifying American black walnut, let's see what wood is. It is, essentially, part of a plant stem. An important division of the stem is the cambium layer, made up of living, growing tissue. This tissue grows by producing new cells and shoving the old ones aside.

The cells forming and eventually dying on the inner side of the cambium layer constitute the wood of the tree, and those on the outer side form the bark. A little reflection will show that the oldest part of the wood is that nearest the center of the trunk, while the oldest part of the bark is at the outer surface. The dead cells forming the bark constantly break and wear away, so that the bark never gets beyond a fairly constant thickness, which, of course, varies according to the kind of tree.

In any oak, pine, birch, walnut, or other tree commonly used for lumber, only a few outer layers of cells in the woody portion are alive. The rest are dead, and may even rot away without affecting the life of the tree. The living, out-

PREPARING SPECIMENS

Sections of dark wood like walnut are seen to better advantage if first bleached with sodium hypochlorite (laundry bleach) and then stained with safranine or other dye. Below, a straight razor can be used to cut cross sections, and a sharp plane will make tangential and radial sections

er wood is called sapwood because it contains watery sap, while the dead part is called heartwood.

The cambium layer produces the annular rings. Annular rings? Perhaps you had better get out your microscope and take a look at some rings before getting more involved in detail. A piece of pine wood will show annular or growth rings better than some of the harder woods like oak. Get a piece of white pine and, with a very sharp knife or razor, cut some thin slices, the thinnest you can make, squarely across the grain. Soaking the wood in water for several hours sometimes will soften it so that it cuts more easily. Select a few of the slices of most uniform thickness, an eighth inch or so wide, and place them on a glass slide. For a permanent mount, simply wet the slices with xylol and mount them in Canada balsam under a cover glass, or follow the steps pictured in the photographs.

Your first impression when you squint through the microscope is that you have made a mistake and got a fragment of exquisite lace on your slide, instead of a wafer of ordinary white pine. This lacy construction is typical of all woods, and is found in considerable variety. It consists of a network of cells. These cells, as you can discover later by examining longitudinal sections, are long tubes running lengthwise with the tree trunk.

Notice how the cells are arranged in bands. Beginning at the rather sharp boundary of one of the bands, observe that the cells are large and comparatively thin-walled. As you move the slide sideways, toward the opposite edge of the band, you find the cells growing gradually smaller until, near the edge, they become rapidly smaller and their walls increase considerably in thickness.

Medullary cells in radial section of oak. They are channels for the cross flow of sap through the tree

Then, abruptly, another series of large, thin-walled cells begins, marking the boundary of another band.

These bands of different-size cells form the annular rings in the pine, and are responsible for the grain of the wood. The large, thin-walled cells were formed during growth of the wood in the spring, when the tree sprang to life rather suddenly after its winter's sleep, and when large volumes of water had to be rushed through them to branches to supply the growing buds, leaves, and branch tips. As the season progressed, the rate of growth slowed down, less water was required, and smaller cells were sufficient to handle traffic. In the fall, when the demand for water fell rapidly toward zero, very small cells with thickened walls were formed.

Pine wood exhibits this difference in cell size more clearly than most other woods because all of its cells act equally as water carriers, and are the type called tracheids. Other woods of more advanced development than pine, such as walnut and oak, have systems of water distribution that include large ducts or tracheae. These cells range from a few inches to a few yards in length, and when observed in radial or tangential sections of wood (see later paragraphs) are seen to have walls marked by spirals or small pits. To obtain cross sections of large ducts, slice walnut, oak, or mahogany across the grain.

These woods present a different kind of lacy beauty. Besides the fairly uniform cells, you will see a number of very large cells among them. The large ones are ducts. The dividing line between the annular rings, sometimes a bit difficult to find, is made by cells that shrank in size rather abruptly at the coming of winter. In comparison with the pine-tree cells, these cells didn't have to regulate their sizes very much for the water required, because the circulation was handled efficiently by the large ducts.

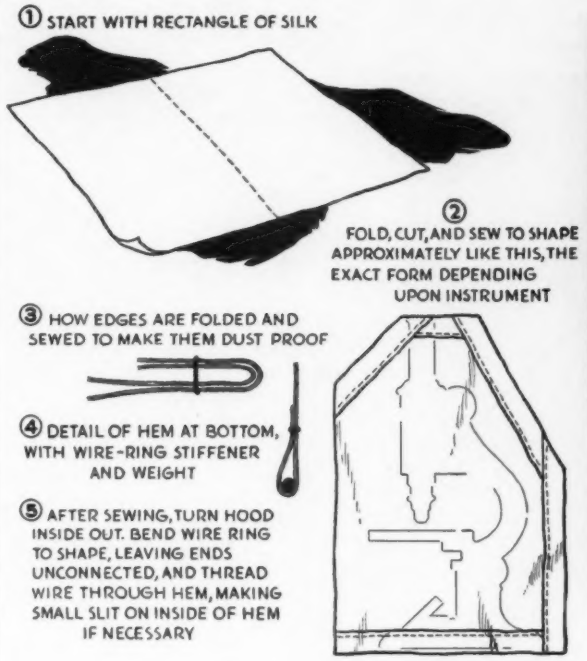
Go back to the pine cross section for a moment. You will find, mostly in the smaller-celled area produced by late-summer and fall growth, groups of distinctive cells arranged in a ring. These form the resin ducts, which are the channels through which resin oozes at the surface of the stump of a freshly cut pine tree.

Next make a cross section of red gum wood, the kind usually used to imitate walnut. Examine it carefully, noting whether it exhibits the large ducts seen in walnut.

• PERMANENTLY MOUNTED SLIDES, PROPERLY

How to make permanent mounts of wood sections. First cut, bleach, and (if necessary) dye them

Then rinse the sections in water and lay them on a clean blotter to remove most of the moisture


① START WITH RECTANGLE OF SILK
② FOLD, CUT, AND SEW TO SHAPE APPROXIMATELY LIKE THIS, THE EXACT FORM DEPENDING UPON INSTRUMENT
③ HOW EDGES ARE FOLDED AND SEWED TO MAKE THEM DUST PROOF
④ DETAIL OF HEM AT BOTTOM, WITH WIRE-RING STIFFENER AND WEIGHT
⑤ AFTER SEWING, TURN HOOD INSIDE OUT. BEND WIRE RING TO SHAPE, LEAVING ENDS UNCONNECTED, AND THREAD WIRE THROUGH HEM, MAKING SMALL SLIT ON INSIDE OF HEM IF NECESSARY

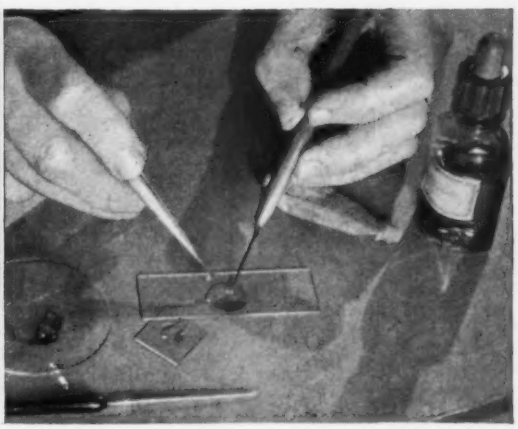
Here's an oiled-silk "topcoat" that will keep dust and dirt out of your microscope

Now you know how to identify genuine American walnut. Look for the large pores formed by the ducts. These will appear either as round holes or elongated openings, visible with the naked eye, depending on the angle at which the wood was sawed with respect to them. Genuine walnut always has these characteristic pores, which are recognizable even though they may have been filled with something during the finishing process.

You can have several evenings of fun merely looking at the cross sections of various woods. But there are other sections to explore. Considering the tree trunk as a whole, there are three common ways of cutting the wood to *(Continued on page 254)*

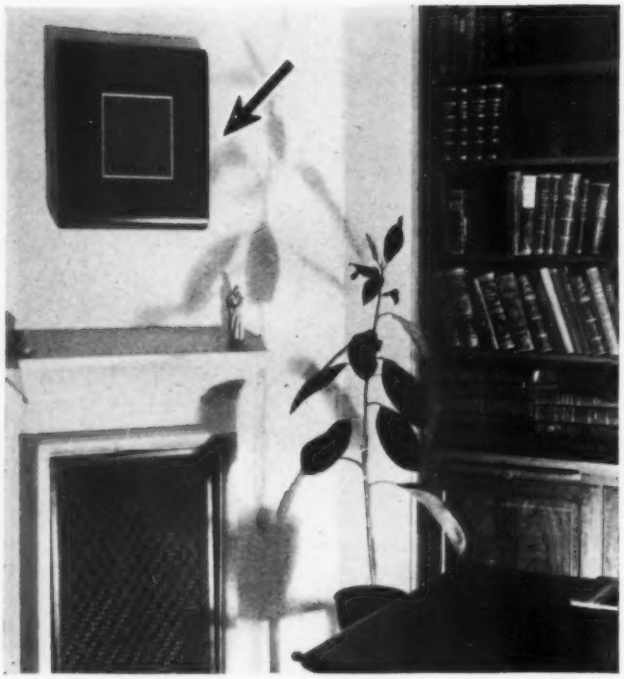
MADE, CAN BE USED OVER AND OVER AGAIN •

Apply dioxan to extract the rest of the moisture. Repeat the process several times as a precaution

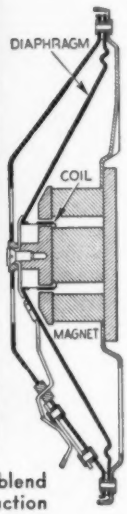


Mount the dioxan-saturated sections under cover glasses in Canada balsam thinned out with dioxan

Seven New Aids for



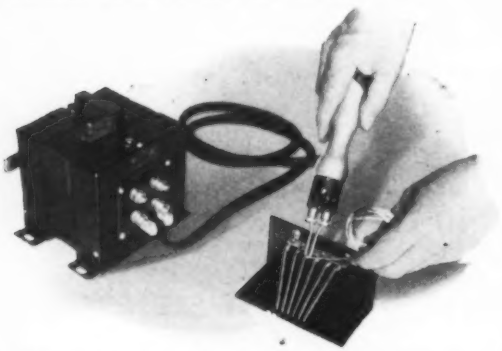
How the thin speaker (arrow) can be mounted on a wall to blend with a room's decorations. The diagram shows its construction



SO FLAT that it can be installed in a picture frame and hung up on a wall, a new loudspeaker embodies a novel design in which the magnet is inside the speaker cone, instead of behind it as in conventional practice. When mounted against a wall or other flat surface, the surface itself becomes an effective baffle board. Since auxiliary speakers ordinarily require either cumbersome baffle boards, or equally cumbersome individual cabinets, the ultrathin speaker makes possible the installation of speaker units in several rooms in a house, each speaker connected to the master radio, without the rooms becoming cluttered. A diagram of the new unit, and a typical installation, are shown in the illustrations at the left.

Unique Soldering Iron Is Economical To Use

CONSUMING electricity only at the moment of soldering a connection, a new soldering iron is economical to use and eliminates many inconveniences of the old-type electric soldering irons. Two electrodes fed by a transformer are short-circuited against solder and the point to be soldered. The heat melts the solder, which makes the union.



This electric iron solders by making a short circuit

Kits Provide All Parts for Making Coaxial Cables

COAXIAL cable for use as antenna lead-ins, transmitter feeders, and the like, can now be made by the amateur radio experimenter in various lengths with kits just put on the market. Cuplike perforated beads are strung on a length of wire. A metallic-mesh jacket is then pulled tight over the partially telescoping beads, and sealed at each end with special clips. All the necessary parts for assembling the cable are supplied in the kits to make lengths of ten, twenty-five, or fifty feet.

Radio Amateurs

Lifting Phonograph Top Resets Pick-Up Arm

AN INGENIOUS installation of the pick-up unit on the underside of the hinged top of record player for radios has two advantages. In the first place, the installation provides a semiautomatic record repeater, since the unit sliding along parallel rods always returns to the starting position when the lid is raised, the needle coming to rest at the beginning of a record when the lid is closed. In the second place, the pick-up travels on a straight track, so that its motion across a record during operation is along a straight line, instead of in an arc as with the pivot-type arm. It is adjustable to either ten or twelve-inch records.

Lowering top of the record player sets pick-up arm in place

When the record is finished, lifting the top returns the unit to starting point

Handy Storage Bins Hold Radio Parts

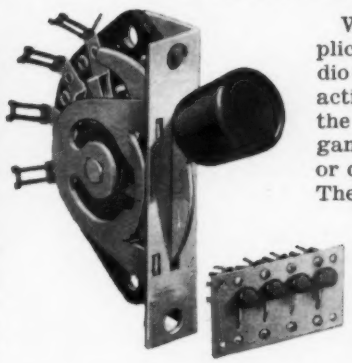
AVAILABLE in a variety of sizes and shapes, bins that can be assembled into a single unit are handy for storing radio parts where they will not clutter up the amateur's workshop. Constructed of steel, the bins may be screwed to a wall, or placed where convenient. A typical assembly is shown in the photograph below.

As many bins as desired can be added to the assembly to fit the amateur's needs

Amateurs' Code-Practice Records

AMATEURS preparing themselves for their station-license examinations can now practice the code by using inexpensive code-practice phonograph records recently put on the market. They can be used on any phonograph and provide a wide range of transmission speeds for the radio beginner as well as those more advanced.

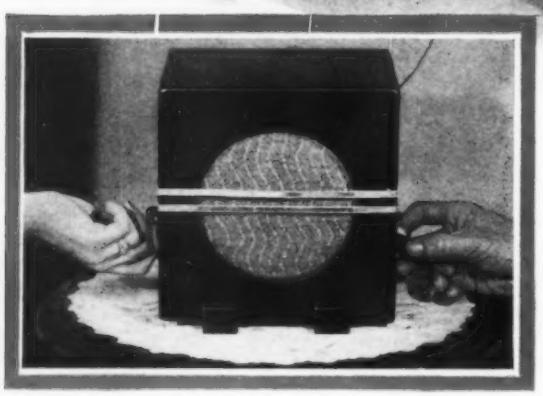
Lever Switch Can Be Ganged



WITH a wide range of applications in the amateur radio field, a low-capacity, lever-action selector switch now on the market can be easily ganged to form double, triple, or quadruple switching units. The selector switch is shown both singly and ganged with a mounting plate in the photographs reproduced at the left. It is equipped with handy connection lugs.

Twin-Bed Radio

CAN BE TUNED FROM EITHER SIDE



At the flip of a switch, either of two pairs of controls on opposite sides of this twin-bed radio will tune and regulate the receiver

By BILL NORTON

WITH two independent sets of controls, mounted on opposite ends of its cabinet, this novel bedside receiver can be operated easily by either occupant of twin beds. A flick of a conveniently located switch instantly changes the operation of the set from one side to the other.

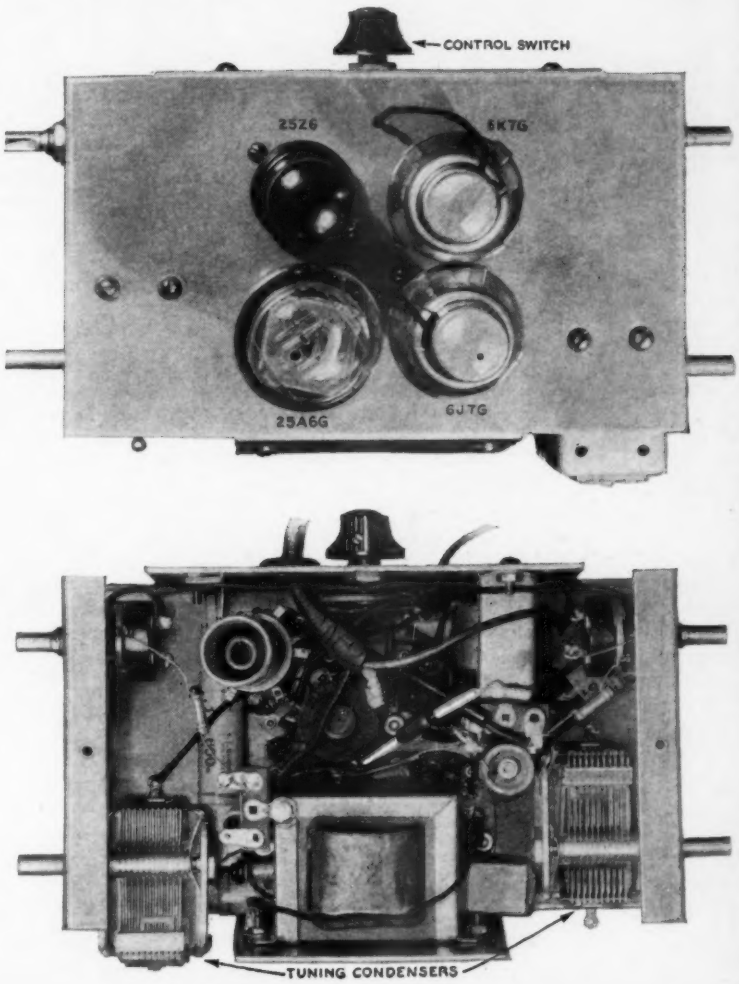
The circuit makes use of four all-electric tubes of the octal type. The filaments of these tubes are designed to function on either alternating or direct current, and in this particular set are coupled to each other in a rather interesting arrangement. The first tube, which is a radio-frequency pentode, is coupled to the detector stage through a high-impedance radio-frequency choke, a .0005-microfarad mica condenser, and a one-megohm resistor, instead of the more conventional radio-frequency coil and tuning condenser. This method was chosen in order to simplify the connections for switching from one set of controls to the other. Two separate tuning stages would have resulted in the circuit being too unstable because of the feed-back through the switch wiring, unless careful shielding were employed.

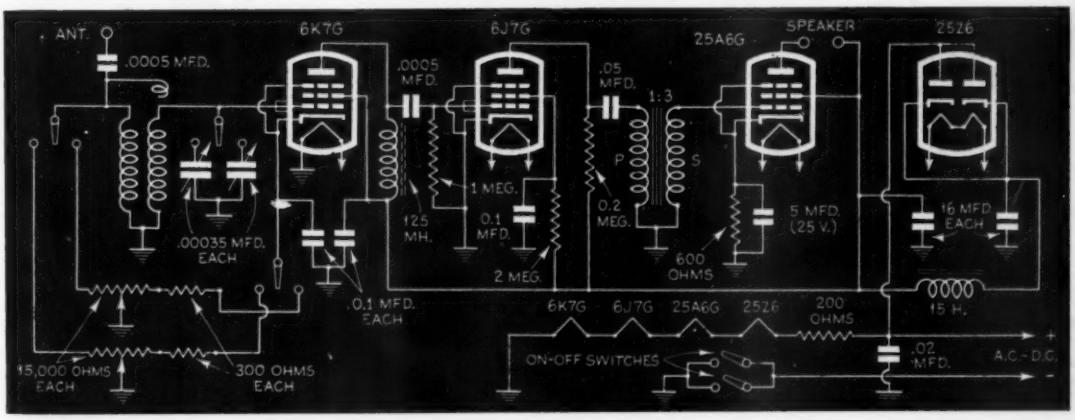
However, choke-coupling of the radio-frequency stage has its disadvantages, the main ones being a slight loss in volume, and broader tuning. To eliminate the latter, an iron-core, radio-frequency choke should be used, together with a well-designed antenna coil. If the reader desires still greater selectivity, he may obtain it by using a shielded, iron-core antenna coil with a low-impedance primary.

The second disadvantage, namely, loss of volume, is eliminated by using impedance-coupling between the detector and audio stages, instead of resistance-coupling. A center-tapped impedance choke is employed for this. It is connected into the grid circuit of the output tube. Since such chokes are hard to find in radio-parts catalogues, a good substitute may be made by using a standardized transformer with a one-to-two or one-to-three ratio.

To change the audio transformer into a center-tapped impedance choke, simply connect the *out* wire of the primary winding to the *in* wire of the secondary winding, and then ground them directly to the chassis. The start of the primary winding then goes to the grid-coupling condenser, while the other end of the secondary winding goes to the grid of the 25A6G output tube. If the reader is unable to determine the correct connections beforehand, all he needs do is try the leads from the transformer first one way and then the other, retaining the connections that give the best results. The output pentode, which is a 25A6G, will easily handle a two-watt output without over-

The circuit's four octal tubes are grouped on the top of the chassis. All other parts but the speaker are below it. Note the two volume-control units and tuning condensers, and the handy selector switch at the back





The chassis is placed well to the rear of the cabinet, to leave room for the speaker mounted behind the front panel

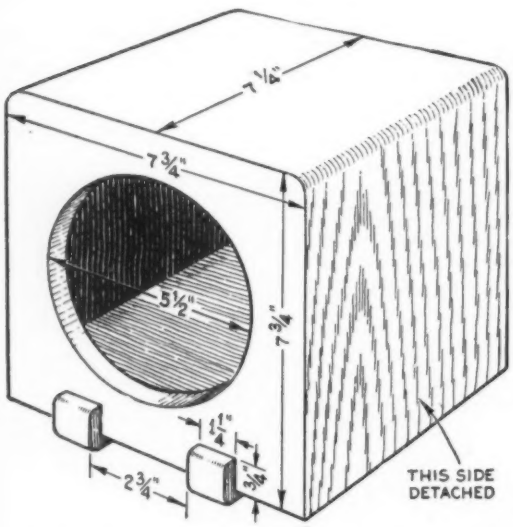
loading, which is ample for most purposes.

In the interests of compactness, a special, six-inch orthodynamic speaker is used to handle the output from the set. Its total depth is only 2¼", which is considerably less than the depth of a conventional six-inch electrodynamic speaker. The magnets of the orthodynamic speaker, mounted directly above the center of the cone, make this saving of space possible.

The switch used in the bedside radio to change the tuning controls from one side to the other is of the three-pole, double-throw type. Since it is impossible to obtain a toggle switch of this kind, a rotary switch such as that used in tube analyzers was chosen instead.

The cabinet, measuring 7¼" by 7¼" by 7¾", is constructed of wood, as shown in the drawing below. Because of the projecting shafts for the dual controls, one side of the cabinet must be made detachable so that the chassis can be slipped into place. To complete the modernistic appearance of the general design, the writer enameled the cabinet black and applied strips of decorative silver banding. Although this can be thin metal, the same effect can be obtained with sections of metal-foil ribbon of the type sold for indoor antennas. These can be cemented in place after the finish has been applied.

Like all A.C.-D.C. receivers, this set requires no ground, the circuit being grounded internally through the house wiring. For an antenna, either an outdoor or an indoor aerial can be used. In the original, a twenty foot length of silk-covered wire strung around the molding gives excellent results.



How the modernistic wooden cabinet is constructed

LIST OF PARTS

6K7G tube.
6J7G tube.
25A6G tube.
25Z6 tube.
Two .00035-mfd. midget condensers.
Two 16-mfd. electrolytic condensers.
One 5-mfd., 25-volt electrolytic condenser.
Three .1-mfd. tubular condensers.
One .05-mfd. tubular condenser.
One .02-mfd. tubular condenser.
Two .0005-mfd. mica condensers.
One line-cord resistor.
Two 300-ohm, ½-watt resistors.
One 1-meg., ½-watt resistor.
One 2-meg., ½-watt resistor.
One 200,000-ohm, ½-watt resistor.
One 600-ohm, 1-watt resistor.
Unshielded antenna coil.
Iron-core, radio-frequency choke.
Three-pole, double-throw switch.
Two 15,000-ohm volume controls with switches.
Audio transformer, 1 to 3 ratio.
Filter choke.

Miscellaneous:—Aluminum chassis, 7½" by 4½" by 3"; four octal tube sockets, four dials, two aluminum shields, two insulated grid-cap leads, speaker, etc.

EASTMAN'S NEW HIGH SPEED FILM

MAKES NIGHT SNAPSHOTS EASY EVEN FOR A $1 BROWNIE

ONCE it took an expert—and an expensive camera—to make snapshots at night. Now the most inexperienced of picture takers are shooting happily away after dark. You need less light indoors than ever before; and you use any camera that takes the new high speed film, Kodak Super-XX—even an inexpensive Brownie. And what pictures you get! Taken instantaneously, with a film four times as fast as ordinary film, they're unposed, informal, full of life.

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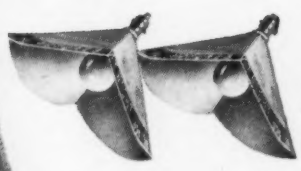
ALL YOU NEED

1. Your present camera loaded with the new Kodak Super-XX Film

2. A couple of inexpensive Mazda Photoflood lamps in Kodak Handy Reflectors



No More Radio Fading....

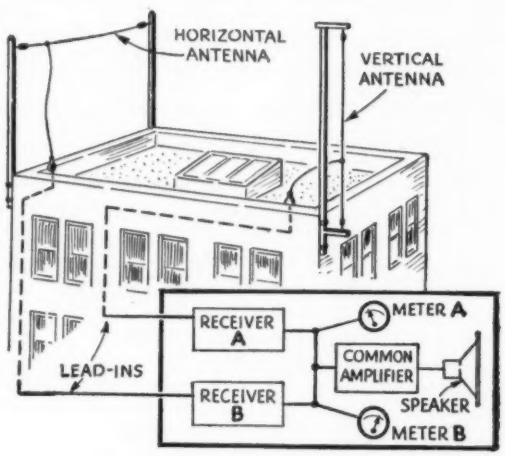
AMATEUR RECEIVER USES TWIN ANTENNAS TO PROVIDE CONSTANT SIGNAL STRENGTH

Two meters mounted on top of the receiver, as shown above, indicate the signal strength in each of the tuning units

FIRST of its kind to be offered amateur radio fans, a new receiver applies the same "diversity reception" principle used by the transatlantic telephone stations to overcome radio fading. Designed to take advantage of the fact that the degree of fading of a given signal varies widely in different receiving antennas, the receiver is in reality twin units connected to a pair of antennas, one rigged horizontally, the other vertically. When a signal picked up by one antenna "fades" or weakens, the other gains in strength in the same proportion. Fed to a single amplifier, their output is automatically mixed and produces signals of constant strength in the loudspeaker.

Some time ago the broadcasting networks began experimenting with this scheme of "diversity reception" to improve the quality of transatlantic programs. When listeners tuned their receivers for rebroadcasts from European capitals, during the recent war crisis abroad, the excellent reception that they obtained bore witness to the success of the new method. With the adaptation of the idea for amateur sets, distance fans can now enjoy the same improvement.

Compactly mounted on the same chassis, the twin receivers of the two-in-one amateur outfit are tuned by a single control, making it as simple to operate as any ordinary set. A three-position switch will cut in whichever receiver, according to visual meters, is receiving a constant-strength signal.



Signals fed to the receiver from two antennas, one vertical, the other horizontal, eliminate fading

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Stunts for Car Owners

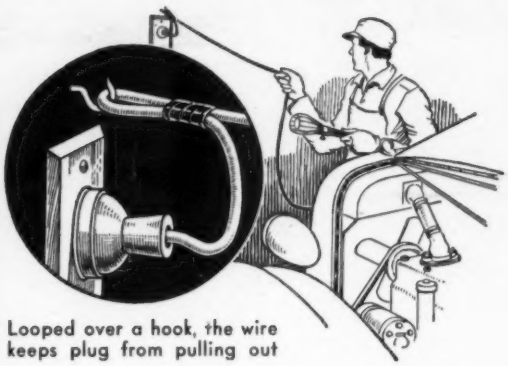
Cut-Away Tire Casings Make Good Mud Chains

OLD tire casings can be made into rubber chains that provide good wheel traction over muddy roads. Slice all the way through the tire at one point, and then cut away eleven sections of the casing to leave twelve ribs, as shown above. In use, the improvised mud chains are slipped over regular tires and fastened at the ends with wire.—A.E.B.

Grip for Greasy Oil Can

SLIPPERY oil cans are sometimes hard to hang onto when working around a car. To eliminate this trouble, I cut a piece of sheet metal in the pattern shown at the right, with a hole in the center and the ends bent around and soldered to form finger loops. This unit was then slipped over the neck of the can and the spout screwed on.—J.A.S.

Greasy oil cans won't slip from your fingers with this simple device



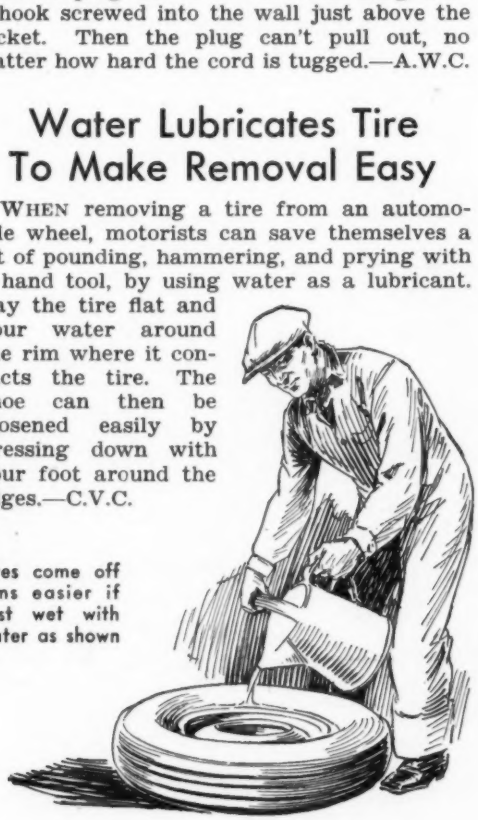
Looped over a hook, the wire keeps plug from pulling out

Cord Looped over Hook Keeps Plug in Socket

TO AVOID the annoyance of having the plug on the end of a trouble-lamp extension cord pull out of the wall socket when the light is being moved about during use, try the method illustrated above. Bind a loop near the plug end of the cord and hang it on a hook screwed into the wall just above the socket. Then the plug can't pull out, no matter how hard the cord is tugged.—A.W.C.

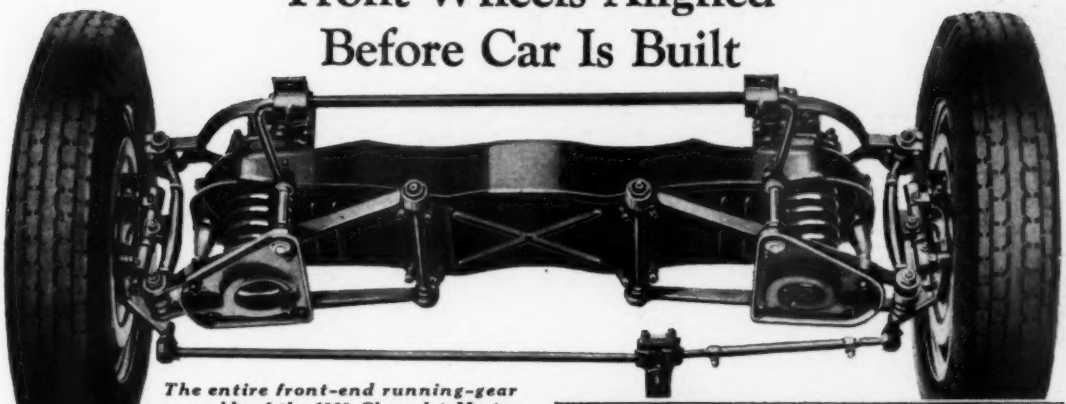
Water Lubricates Tire To Make Removal Easy

WHEN removing a tire from an automobile wheel, motorists can save themselves a lot of pounding, hammering, and prying with a hand tool, by using water as a lubricant. Lay the tire flat and pour water around the rim where it contacts the tire. The shoe can then be loosened easily by pressing down with your foot around the edges.—C.V.C.

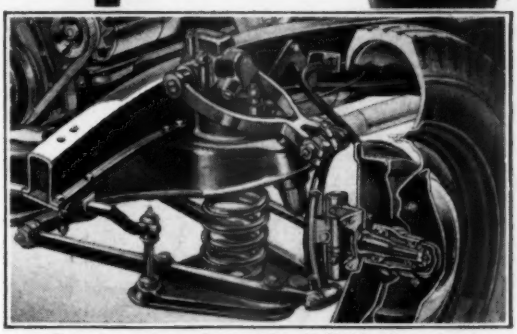


Tires come off rims easier if first wet with water as shown

Front Wheels Aligned Before Car Is Built



The entire front-end running-gear assembly of the 1939 Chevrolet Master De Luxe model forms a single unit.



Cutaway view shows the individual spring suspension, or Knee-Action, of the new 1939 Chevrolet Master De Luxe.

With the adoption of a completely new design of Knee-Action for its 1939 Master De Luxe models, Chevrolet has put in effect a revolutionary improvement in motor car assembly systems. Instead of being added to the chassis piece by piece on the final assembly lines, the entire front end is assembled at the manufacturing plant at Detroit, and shipped as a unit, ready for bolting to the chassis frame at Chevrolet's assembly plants throughout the country. This system assures that every car will leave the line with its wheels aligned and its steering gear adjusted to the exact standards set up by the engineering department.

At the manufacturing plant in Detroit, each front-end unit is placed in an elaborate master jig which gauges every part and locates it accurately before the assembly is finally tightened up and its parts locked in permanent position. When the unit is bolted to the chassis frame at a car assembly plant, no further check is required to insure correct steering and wheel alignment. Ordinarily, these adjustments are made on the car assembly line, where variations in tires, tire pressures, front springs, etc., tend to prevent exact uniformity in the alignment and steering.

For service work, the entire front end—comprising the front cross-member, Knee-Action suspension, shock absorbers, torsional sway eliminator, king pins, steering knuckles and spindles, steering pitman arm extension and tie rods, hydraulic brakes and front wheels—may be removed as a unit without disturbing the original wheel alignment and steering adjustments.—Chevrolet Motor Division, General Motors Sales Corporation, Detroit, Mich.

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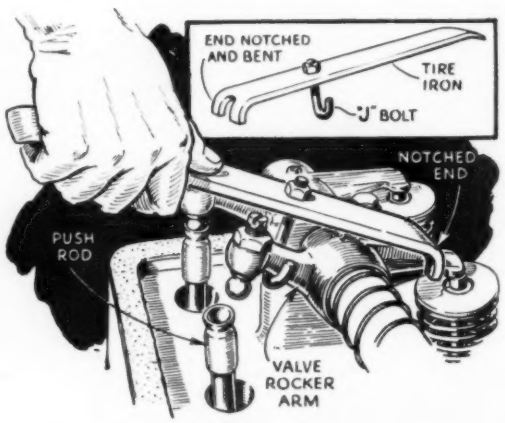
75th ANNIVERSARY YEAR

Simple Way To Paint Wire Automobile Wheels

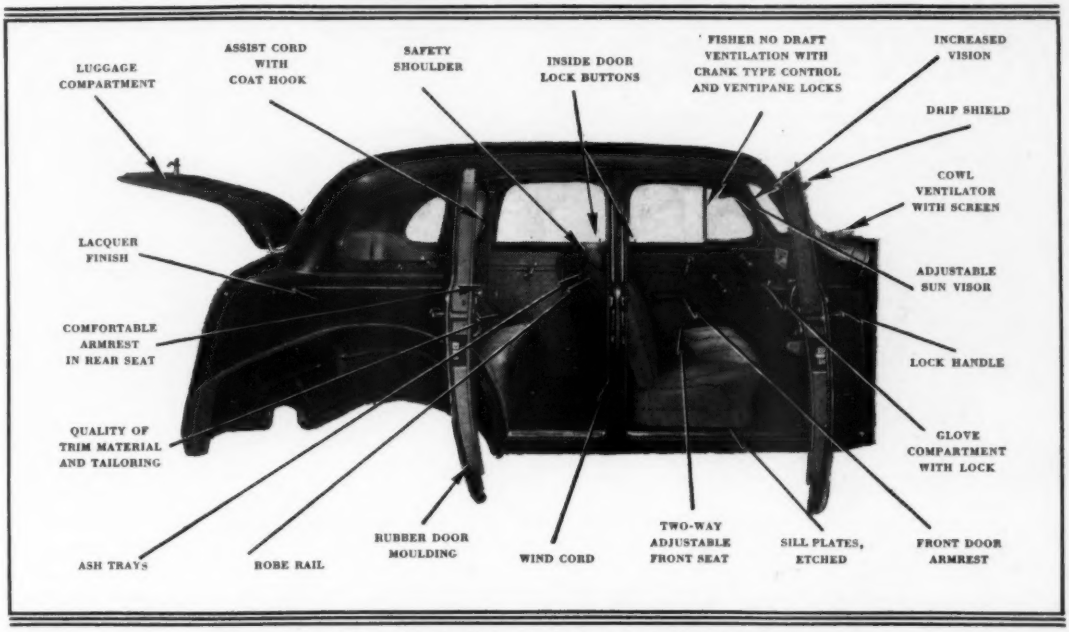
WHEN painting wire wheels, you can save yourself time and trouble by piling the wheels one on top of the other and spraying down through the whole batch. The rims form an inclosure that prevents the spray from spreading, and each wheel gets well covered. Excess paint can be removed with a gasoline-dampened rag.—A.C.M.

Special Rocker-Arm Tool Removes Valve Push Rods

A HANDY tool for removing and replacing valve push rods on overhead-valve engines can be made from an old tire iron. Notch one end and bend the two points down sharply. Fit a J bolt loosely through a hole about three inches from the slot. Used as shown in the drawing below, it will prove a valuable aid for valve work.—F.A.R.



FISHER FACTS



They're saying, "Chevrolet's the Choice" in the low-price field—and the diagrammatic drawing above quickly shows that its Body by Fisher is one of the best reasons why.

NEW LIGHTS on LUXURY

—in the new Body by Fisher

LUXURY starts back of the assembly line in the new Unisteel Body by Fisher — thanks to Fisher engineers.

For it is a luxury, indeed, to have a car body that is all in one substantial steel unit — from seamless steel Turret Top, through all the steel panels and reenforcements, right down to the solid steel floor.

But, of course, this inseparable unity of the Unisteel Body is only the beginning of the luxuries with which it adds so much extra value to the 1939 General Motors cars.

For instance, its steel Turret Top, all of its steel panels and even its steel floor are scientifically insulated against heat, cold and noise.

Yes, luxurious comfort is as important in the new Body by Fisher as is its Unisteel resistance to wear, weaving, jolts and shocks. Just sit in its wider, more comfortable seats — look at all the fine new fabrics and jewel-like appointments that Fisher craftsmen have fashioned this year.

And just note the increased visibility they've provided for greater safety!

No wonder people are saying "For 1939 better buy the car with Body by Fisher."

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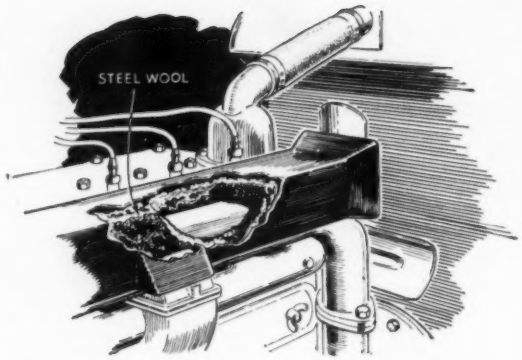
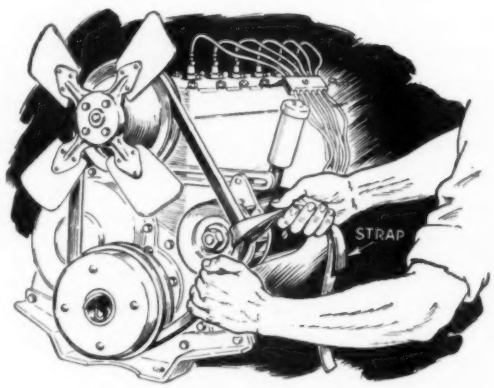


Steel Wool Improves Car's Hot-Air Heater

YOU can make your manifold-type, hot-air heater much more efficient by inserting a fluffy wadding of steel wool in the heater casing so that it comes in contact with the manifold, as shown. It should be packed so that it slows up the flow of air and provides a larger heating surface, but not so solidly as to create any danger of overheating the manifold. It is a good idea to fill the heater only half full at first. If this is not enough, more wool can be added until adequate heat is provided.—S.L.

Leather Strap Is Aid in Installing New Fan Belt



USE of a leather strap helps when installing a new fan belt on a car. Place the fan belt over the fan and crankshaft pulleys, and loop the strap around the fan belt as in the drawing above. Pulling the looped strap makes it an easy matter to stretch the new belt so that it easily slips over the generator pulley.—N.V.

This is the spark plug Champions use!

The best spark plugs for your car are those that are outstanding in open competition. In racing, Champion Spark Plugs are the choice of racing champions. Because of the better performance they bring to every engine, Champions have for fifteen consecutive years equipped the vast majority of all victorious racing engines everywhere.

IT IS THRIFTY TO INSTALL NEW SPARK PLUGS — *DEMAND CHAMPIONS*

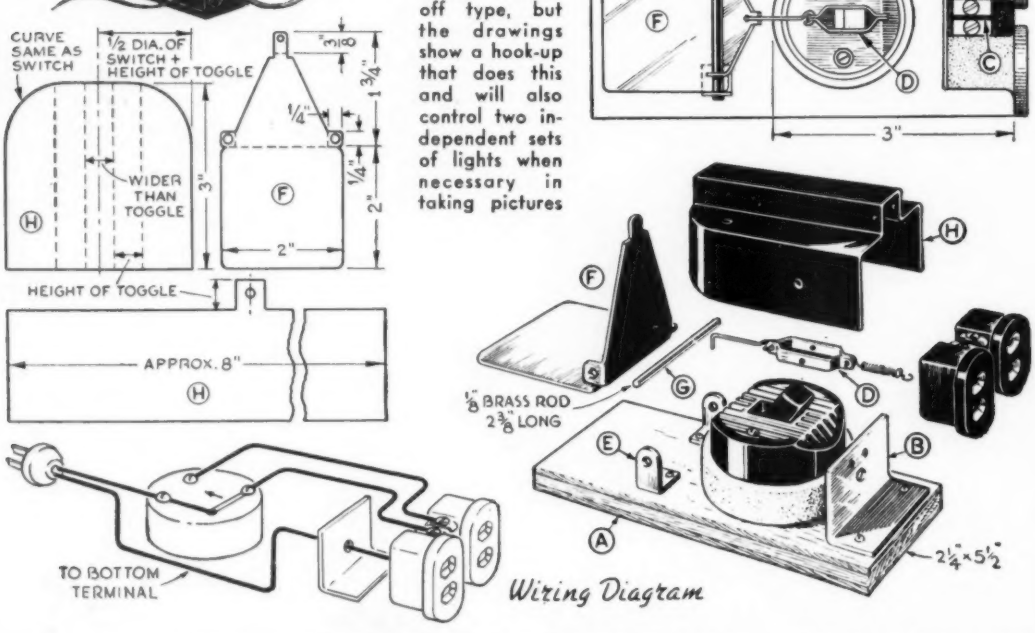
Photographer's Foot Switch

CONTROLS LIGHTS, ENLARGER, OR PRINTER

BUILT around a standard toggle switch designed for external mounting, this photographer's foot switch is valuable for use with photofloods, enlargers, and printing boxes. For lighting purposes it is desirable to use a three-way rather than a two-way switch; 60- or 100-watt bulbs may then be mounted alongside the photoflood lamps so that all focusing and posing are done by their reduced light. As long as the foot is kept on the pedal, the small lamps are on, but when the foot is raised, they snap off and the photofloods switch on.

On base *A* is mounted a special bracket *B* of heavy gauge metal. One of the terminal plates of a duplex outlet is cut with a hack saw as at *C*, and the slot filled with sealing wax or airplane cement. The outlet is then fastened to bracket *B*. Next, the switch is wired as shown and screwed to the base. The yolk *D* is held in place by a rod that passes through a 1/16" hole drilled through the toggle. The stiff wire pedal connector is fastened to one end of the yolk, and a spring of sufficient *(Continued on page 232)*

For most uses the switch may be of the ordinary on-and-off type, but the drawings show a hook-up that does this and will also control two independent sets of lights when necessary in taking pictures



Wiring Diagram

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- **CANDID MIDGET**—Schneider F:2 lens, Rapid Compur, Eveready case, list $84.75 ..... $54.75
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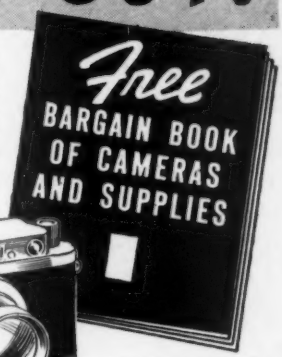

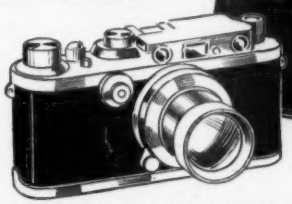

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(They're easy to take with G-E Photofloods)

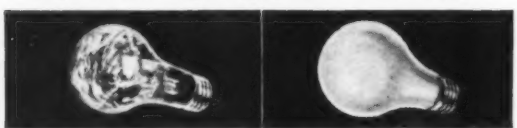
"LOOK at my swell birthday pictures," says Molly. "And Daddy's *so* proud . . . says he's going to take lots of indoor snaps now that he's found how easy it is with G-E Photofloods.

1. "When Mummy brought in my cake I forgot all about Daddy's camera and how bright the room was. Maybe that's what makes these snapshots look so natural.

2. "I did hear several clicks as I began to blow. But after all, a cake is more serious business for a gal with a birthday.

3. "Daddy's tickled pink with this picture. And Mummy says she's so glad he thought to take indoor snapshots. I say, 'Happy Birthday'."

BIRTHDAY COMING? *Take indoor "snaps" with your camera. Go to your film dealer for G-E MAZDA Photoflood lamps and new "super" type film that make it easy.*



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No. 1 (was 25c) now **20c** list
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No. 10 . . . . . **15c** list
Brand New
No. 21 (Synchro-Press) **20c** list

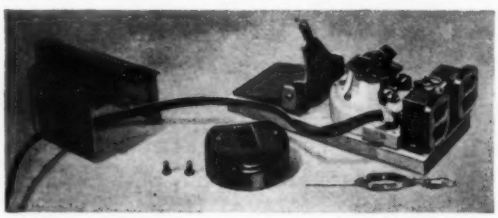
GENERAL ELECTRIC
MAZDA PHOTO LAMPS

Photographer's Foot Switch

(Continued from page 230)

strength to snap the switch is fastened to the other end.

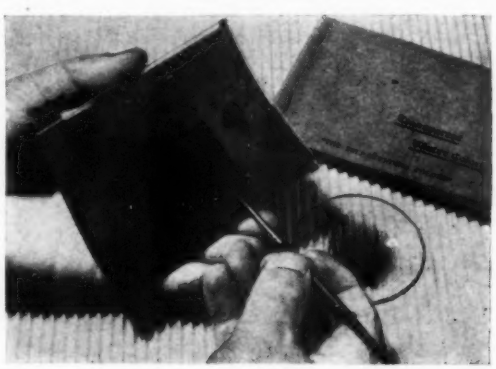
The pedal supports *E* and pedal *F* are made of 1/16" stock and assembled with rod *G*. The housing *H* is fashioned from two pieces of sheet metal, soldered on the inside. Holes for the lead-in wires and pedal connector are drilled. The screws holding the switch cover are removed, the housing is fitted in place, and two holes are located on it immediately above those in the cover. The screws are then replaced to hold both housing and switch cover. The spring is hooked to a small rod that fits in two holes near the open end of the housing as shown in one of the drawings. A piece of rubber should be glued to the base.—HENRY and RICHARD HANSCOM.



Assembled switch. The pedal is adjusted so that it does not quite touch the base as the switch snaps

Photo-Tinting Colors Used for Doctoring Negatives

WATER colors used for tinting photographs are also suitable for doctoring or for blocking out portions of negatives. For the latter purpose use a deep red. To hold back portions of a negative that would otherwise print too dark, choose a light shade or yellow. When an entire negative is too thin to print satisfactorily, tint it evenly with dilute orange color to lengthen the printing time.



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—*the MILDNESS* of fine old Kentucky Burley aged in wood

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Velvet packs easy in a pipe
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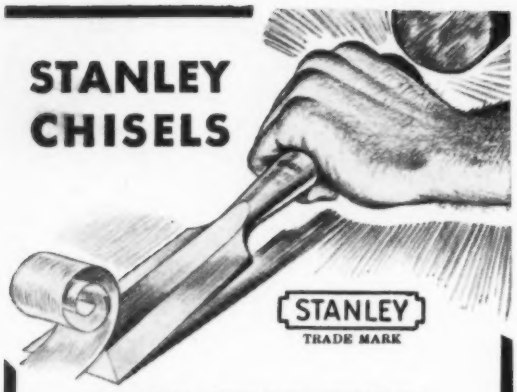

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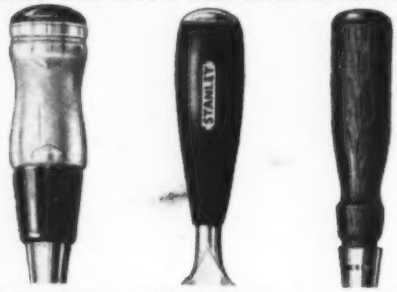

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Built for a lifetime of hard service. A one-piece forging from head to blade transmits hammer blows direct to cutting edge. Rubber composition handle. Tool steel blade.

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NO MATTER what type of project you intend to build this spring, you will find that blueprints drawn to a definite scale and tested by experts will eliminate most of your workshop problems. For seventeen years we have been supplying amateur craftsmen with a wide variety of plans. Some of them are given below. A complete list will be sent upon receipt of a self-addressed, stamped envelope.

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Cabin Cruiser, 17' long, weighs 750 lb., for use with outboard or inboard drive, 356-357-358-359 ..... $1.00
Folding Duck Boat, 13' long, 170-R ..... .50
High-Speed Boat for Small Outboard Motors, 7'11" long, 257-R ..... .50
Midget Boat or Pram, 9' long, for oars, sail, or outboard motor, 339-R ..... .50
Motorboat-Rowboat, 13' long, with decked hull, for use with outboard or inboard drives and oars, 147-R ..... .50
Racing Sailboat BLACKCAT, 13'4" long, weighs 250 lb., Marconi rigged, 321-322-323-R 1.00
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Sport Runabout, 9'8" long, for small outboard motors, weighs 100 lb., 309-310-R ..... .75
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Cody Coach, 13" long, 144-145-146-R 1.00
CONSTITUTION ("Old Ironsides"), 21" hull, 57-58-59-R 1.00
Cruiser U.S.S. INDIANAPOLIS, 12" long, 216 ..... .25
Farragut's Flagship HARTFORD, 33½" hull, 221-222-R 1.50
MAYFLOWER, 24" long, 83-84-85-R 1.00
New Bedford Whaleboat, with complete equipment, 14" long, 326-R ..... .50
Old Naval Gun, a six-pounder in battery; gun is 7⅜" long; 9" by 11½" overall, 352 ..... .25
Privateer SWALLOW, a Baltimore Clipper, 13" hull, 228-229-230-R 1.00

(Continued on page 236)

"No one—it seemed—could find the answer"

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"Last September—three months after I had spent $12.00 for a well known battery—I began having starting trouble! During the winter I had to be pushed at least 15 times! And each time I got madder. Battery dealers would look my battery over—test it—recharge it again . . . and in a week or so I'd be in trouble again. *No one could find the real answer!*

"Finally someone told me about *Willard Starting Service.* I went to a Willard Dealer and in a few minutes he found the cause of the trouble, *which wasn't in the battery at all!*

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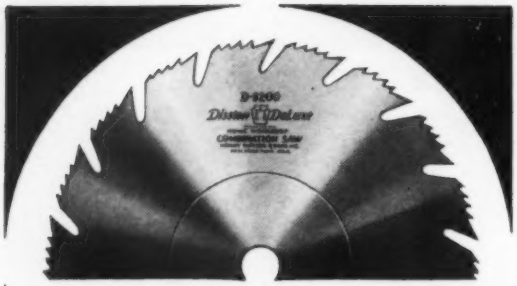
You can identify our station by this sign.

If you are interested in the "why" and "how" of the instrument that makes this service possible, send a letter or postcard to Willard Storage Battery Company, Dept. C-3, Cleveland, Ohio.



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6" (½" hole) $2.70 — 8" (½", ⅝", ¾" hole) $3.50
7" (½" hole) $3.10 — 10" (⅝", ¾" hole) $4.50

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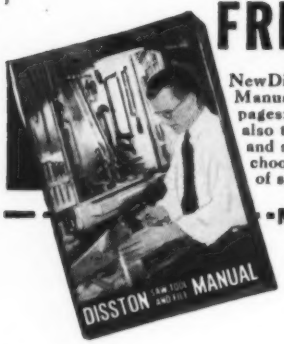

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(Continued from page 234)

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U. S. Battleship TEXAS, 3' hull, 197-198-199-200 ..... 1.00
Viking Ship, 20½" long, 61-62-R ..... .75

[Construction kits are available for some of these models. Turn to page 238.]

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Colonial Writing Desk, Governor Winthrop style, 3'6" high and 3'8" long, 21 ..... .25
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End Table, American Empire, 241A ..... .25
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Kitchen Table Cabinet, 27" by 48" top, has folding seat (no turning), 27 ..... .25
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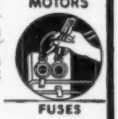

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This Handy Sander is a high-grade tool, made of steel, cadmium plated. Furnished with best quality **Abrasive Cloth,** cushioned with ⅛" thick Sponge Rubber. Light in weight, but strong, fitting hand perfectly. The soft springy action relieves hand and arm strain. Protects fingers from abrasive cuts. **The only hand sander that gives an even pressure over its entire surface.** Not only flat work, but also on irregular shapes and round work. No waste—every bit of abrasive may be used. **Foreign Price $1.00.**

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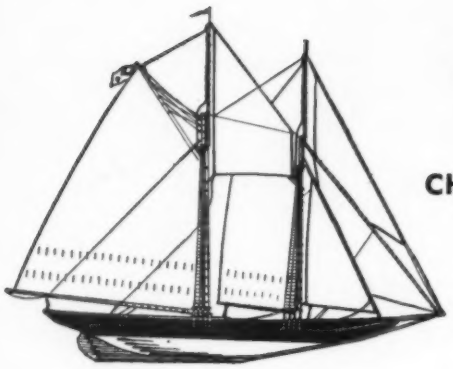

Packaged Materials
FOR BUILDING A MODEL OF
The 'BLUENOSE'
CHAMPION FISHING SCHOONER

IN A series of thrilling races off the New England coast near Gloucester last year, the fishing schooner *Bluenose* retained her crown as undisputed sailing champion of the North Atlantic. You can build a beautiful model of this famous Canadian salt banker with our construction kit No. 8S. All the necessary raw materials, as well as instructions and full-size blueprints, are contained in the package. We also have kits for many other models; a complete list follows:

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. MANHATTAN, 12" long.....$1.00
H. Cruiser U.S.S. INDIANAPOLIS, 12" long..... 1.50
J. Clipper SEA WITCH, 9½" hull, 13" over all.... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier SARATOGA, 18" long..... 1.00
N. Convoy of four U.S. destroyers, each 6¼" long .75
R. U.S. cruiser TUSCALOOSA, 11¾" long..... 1.00
U. HISPANIOLA of the book and movie "Treasure Island," 7" long..... .50
Z. H.M.S. BOUNTY, 8½" hull, 11½" overall..... 1.50
2M. Ocean freighter, 14" long..... 1.50
3M. Yacht NOURMAHAL, 8⅛" long..... 1.00
5M. Liner PRESIDENT LINCOLN, 14¾" long.... 1.50
6M. Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all..... .75

MODEL RAILWAY KITS

1L. HO-gauge, Hudson-type model locomotive and tender, 14" long..... 9.95*
2L. Supplementary power unit for locomotive 1L; consists of 6-volt motor and worm and gear 4.50
3L. HO-gauge track kit. Contains raw materials for making 25 ft. of track..... 4.00*
4L. Deluxe track kit. Same as 3L except that kit contains third-rail chairs..... 6.95*

STANDARD SHIP MODEL KITS

A. Whaling ship WANDERER, 20½" hull, 27" over all 7.40*
D. Spanish galleon, 24" hull, 30" over all..... 6.95*
E. Battleship U.S.S. TEXAS, 3' long..... 7.45*
G. Elizabethan galleon REVENGE, 25" hull, 28" over all 7.25*
L. Farragut's flagship HARTFORD, steam-and-sail sloop-of-war, 33½" hull, 41" over all..... 8.45*
Q. Privateer SWALLOW, a Baltimore clipper, 12½" hull, 20" over all..... 4.95†
V. Clipper SOVEREIGN OF THE SEAS, 20½" hull, 26" over all..... 4.95†
Y. Trading schooner, Maine type; 17½" hull, 22½" over all..... 4.90†
2S. U.S. Navy destroyer PRESTON, 31½" long 5.95*
3S. CONSTITUTION ("Old Ironsides") 21" hull, 31" over all..... 6.50*
4S. Clipper ship GREAT REPUBLIC, 31½" hull, 42" over all..... 8.40*
5S. Coast Guard Patrol of 165-ft. type, 20⅝" long (same as President's yacht POTOMAC)..... 4.95*
6S. Brig MALEK ADHEL, 20" hull, 33" over all; frame-and-plank construction ..... 9.75†
8S. Fishing schooner BLUENOSE, 17½" hull, 22" over all ..... 4.95†
9S. New Bedford whaleboat, with complete equipment, 14" long ..... 2.75†
10S. Confederate raider ALABAMA; steam sloop, bark rigged; 21½" hull, 28" over all..... 8.20*

MISCELLANEOUS

7. Whittling kit with two shaped blocks for making sea captain 5½" high..... 1.50
8. Whittling kit for six different Scotties; each is 2" by 2¼", sawed to shape..... 1.00
10. Copycraft whittling kit for making one of several Hobo Hank novelties. Includes master model 5¾" high..... 1.50
12. Marionette kit for making a model of Dopey the Dwarf, 9" high. Hand-painted head and complete parts, ready to assemble..... 2.25†

You can build a model of a liner with our kit F

Note: If you live west of the Mississippi River or in Canada, add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†).

Popular Science Monthly, Dept. 39A
353 Fourth Avenue, New York, N. Y.

Please send me C. O. D. Kit.....

I will pay the postman the price shown above plus a few cents postage in full payment. (Canadian orders cannot be sent C. O. D.).

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(Please print your name and address very clearly)

If you prefer to send your remittance with this order, you save the C.O.D. charge. Remit by money order, check, or registered mail. This offer is made only in the United States and Canada. Also see note above.

PRESTO! ANYONE CAN MASTER GLAZE

LEAVES HARD GLASS-LIKE FINISH

SEALS THE PORES OF THE SURFACE

EASY TO APPLY

PROTECTS THE SURFACE

WILL NOT FINGER-MARK

NO OILY FILM AS WITH POLISH

EASY TO KEEP CLEAN

NO SMEAR OR STREAKS AS WITH WAX

LASTS SIX MONTHS TO A YEAR

SAVES YOU MONEY

It's Different! AMAZING NEW GLAZE BEAUTIFIES and PROTECTS

Car Owners Praise MASTER GLAZE

I have used a great many polishes, and waxes, but will say Master Glaze is the winner. Clarence Gray, Calif.

IT LOOKS SWELL

Master Glaze is the best I have ever used and is put on the easiest. I glazed my car last Sunday, and boy!—does it look swell. Lewis Thompson, Ill.

STANDS THE TEST

Master Glaze has been put to the test here directly in front of the Atlantic, where the salt spray with the fine beach sand, including road dirt, form a heavy film on paint. Your Cleaner lifted the film and brought back the original shine. H. M. Chambers, N. J.

LONG LASTING

Used Master Glaze on my car last summer. It stood up all winter in good shape. Now my friends are asking about it, so will sell. A. Stonis, Ill.

SELLS 8 IN HOUR

Master Glazed a car on a demonstration in the parking lot and sold eight sets within one hour. I am delighted with it as a fine product and as a good seller. Edmund M. Blanken, Pa.

VERY MUCH PLEASED

Received shipment of 96 sets and have been very much pleased with the way it sells. It out-demonstrates any and every type of cleaner and polish I have seen. Dave Jones, Mont.

CAR Owners! Meet MASTER GLAZE—the sensationally different luster for new and used cars!

Not a wax—not an oil polish—not a paint—nothing that "smears" over the surface. It's a creamy liquid—quick and easy to apply. A matchbox full is enough to glaze an entire car! Enables every motorist to keep his car finish sparkling—beautiful as a showroom car. Also amazingly restores gleaming luster to dull weather-beaten cars. Gives a hard glass-life surface without smear or streaks! Nothing like it!

Millions of motorists have the problem of keeping their cars looking new. They all want gleaming, shiny, streak-free appearance without hard work and rubbing. Now with this new and different Master Glaze method, anyone can quickly and easily Master Glaze his car, obtaining sparkling brilliance, with a beautiful, smooth, mirror-like surface.

Master Glaze is so durable—so protective to the surface—that even washing with gasoline does not affect its brilliant luster. Lasts six months to a year!

It's Fun To MASTER GLAZE

It's really a pleasure to Master Glaze. You almost feel like a magician when you see the quickness and ease with which you can transform your car into a thing of gleaming beauty. New cars and good paint jobs are entitled to this protection—old cars with dull paint almost instantly look like different cars. No experience is required. Even a child can Master Glaze.

New Car Beauty SAVES YOU MONEY

Master Glaze glorifies the beauty of your car, protects the finish, and saves you money. Less washing, less polishing, less work. You will have a more beautiful car to drive, and a car whose resale value will always be more. You owe it to yourself and to your car to find out about Master Glaze. Send your name for free booklet and free trial offer.

AGENTS - **Write for Big Profit and Free Offer Plan**

Choice territories open. You can make big money taking care of local business and get Master Glaze for your own car free by helping introduce it. Don't delay. Send the free offer coupon today!

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Gentlemen: Please send your FREE illustrated booklet and tell me how I can get Master Glaze for my own car FREE. This does not obligate me in any way.

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Home Workshop Handbook

● Helps woodworkers from beginner to Master Craftsman. Contains a list of free and low-cost booklets offered you by leading experts on Tools, Finishes, Sharpeners, Cabinet Woods and Veneers, Project Plans and Workshop Clubs. First book with *all* this information. Mail coupon *now* for your copy. (Save 2c—stick coupon on penny postcard.)

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Yes, send me your free "Home Workshop Handbook"

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Now! Goodbye to SANDING Drudgery!

Guild ELECTRIC PORTABLE ***Sander***

This handy portable belt sander does better work in a few minutes than you can do by hand in several tiresome hours.

Driven by a powerful motor, the endless abrasive belt skims over any surface, flat or rounded, and leaves it clean and smooth. Always works with the grain—can't scratch or leave ugly, circular swirls. It works on wood, wall board, metal, slate, marble, bone and plastics. You'll discover scores of uses for GuildSander around the house and in the shop.

Popular priced and fully guaranteed in writing. Weighs only nine pounds. Works on AC or DC. Try it at your hardware dealer's or write direct for details.

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GRINDS
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BUFFS
SHARPENS
REMOVES PAINT VARNISH RUST

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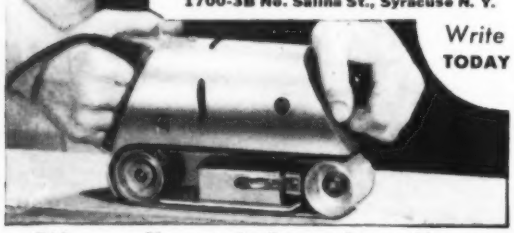

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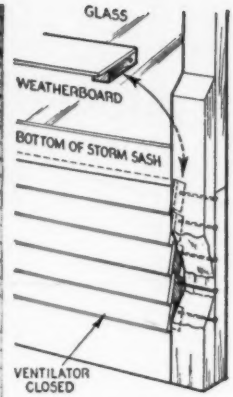

A storm sash is obtained 14" shorter than the window, and the space below is filled with shutters

Shutters on Storm Sash Ventilate Bedroom

VENTILATING a bedroom during severe weather often causes difficulty, but it can be accomplished by the method illustrated. A regular storm sash is obtained about 14" shorter than the window. To fill the space under it, five shutters are made from ordinary 3½" weatherboard or siding. Cleats are nailed across the ends of the shutter to prevent warping and splitting. These are fastened either on top of the shutter as illustrated in the photo or underneath as shown in the drawing. The shutters are then mounted in a frame made as shown. They may be closed during the day and opened at night to let in any desired amount of air when the inside lower sash is raised, but keep out rain, snow, and direct winds. In the spring, the sash and ventilator are replaced by the regular screen.—C. W. RICKMAN.

Painting Stripes or Bands on a Plastered Wall

WHEN a stripe or band has to be painted on a plaster wall, the task can be made much easier by using a penknife and straightedge to mark both edges. The paint, applied between these incised lines, will not flow beyond them. I have found an angle-cut brush is the most convenient to use. This method, if carefully carried out, will give the amateur an even cleaner-looking job than the use of regular masking tape.—LEO LUCCHI.

HOW TO WORK IN Wood

Here is Harold Hunt's remarkable NEW 1939 catalog and guide for woodworkers.

NEW IDEAS FOR THE EXPERT

Page upon page of the latest up-to-date information; new patterns, novel designs, new devices.

Six new pages on wood finishing, the knacks, the little secrets, **correct** processes of finishing.

Extra facile method of inlaying; even a beginner can do it.

235(!) **brand new** scroll and fret patterns; choice new designs for trimmings; also new types of hardware. And so on and so on.

A GUIDE FOR THE AMATEUR

Complete, detailed directions—so that the merest beginner can start right in with nothing but a hammer, saw and plane (or with a scroll saw) making beautiful furniture. You should see how absolutely clear everything is made for you in this Catalog:

1) Just what tools you need, beginning with only the three or four everyday tools probably now in your basement.

2) Just what lumber to buy and in what sizes and exactly what hardware and miscellany for the things you decide to make.

3) Then precise, detailed directions with the pattern you pick.

Also Big Bargains!

Besides listing ALL the standard American woods and 35 rare imported woods, including the choicest, hard-to-find, fancy woods, many of these at astoundingly low prices **and besides**

Showing page upon page of carvings, trimmings, tools and hardware while posting you always on present best prices,

Besides all these thousands of quotations, this catalog contains a series of "deals," some 20 to 25 simply baffling bargains in lumber, veneers, and inlays.

For all these bargains (and for right prices on every kind of woodworkers supplies) read 1939 catalog.—**See coupon at left.**

What is the favorite hobby of wealthy business men?—Golf attracts the largest number. But for intensity of interest, wood working easily ranks first.

This man started with a **$1.98** scroll saw outfit. Now the same man has a complete work shop in his basement. He has built up this hobby, improving and perfecting it, until he now earns a tidy sum in his spare time. He makes bookcases, beautiful hall clocks and elegant lamps, all made in his basement, in his spare time!

What a joy to create! What a satisfaction to see the products of one's imagination and handicraft in use, in constant use, by the family and by friends!

Read in the new CATALOG No. 12, the interesting letters of wood-workers, wealthy men, poor boys, old men, young men, those who work for fun and those who work to make money.

☛Our last previous catalog No. 11 was in such demand that we were unable to supply delayed inquiries.—**To make sure** of getting this latest 1939 edition catalog No. 12, **better write at once!**

Tired businessmen: get back to this absorbing hobby; it beats golf; you know it does.

Write for this Book

Harold Hunt, President
CRAFTSMAN WOOD SERVICE CO.,
2723 S. Mary Street, Chicago, Ill.

I enclose 10c (stamps or coin) for which please send new 136-page Catalog No. 12, latest 1939 edition.

Name.....

Street and No.....

Town..... State.....

SHORT CUTS FOR THE CRAFTSMAN . . . NO. 4

How to touch up a lathe tool or a bit

The secret of touching up lathe tools as well as fluted reamers, auger bits, plug cutters or similar edged tools lies in using an abrasive stick of the right grit and shape. Special Carborundum-made abrasive sticks in a wide variety of shapes are available at your hardware store.

Honing square or round holes to size is a simple trick when you have the proper shaped abrasive stick. You can also use Aloxite and Carborundum Brand sticks to advantage in stoning dies.

Ask your hardware or mill supply dealer for Carborundum-made sticks, stones, grinding wheels and other abrasive products. Send 20¢ coin or stamps for sharpening stone and valuable illustrated manual on how to save time and money by using abrasive products.

Write Dept. PS 3-9

THE CARBORUNDUM COMPANY, Niagara Falls, N.Y.

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CARBORUNDUM

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ABRASIVE PRODUCTS

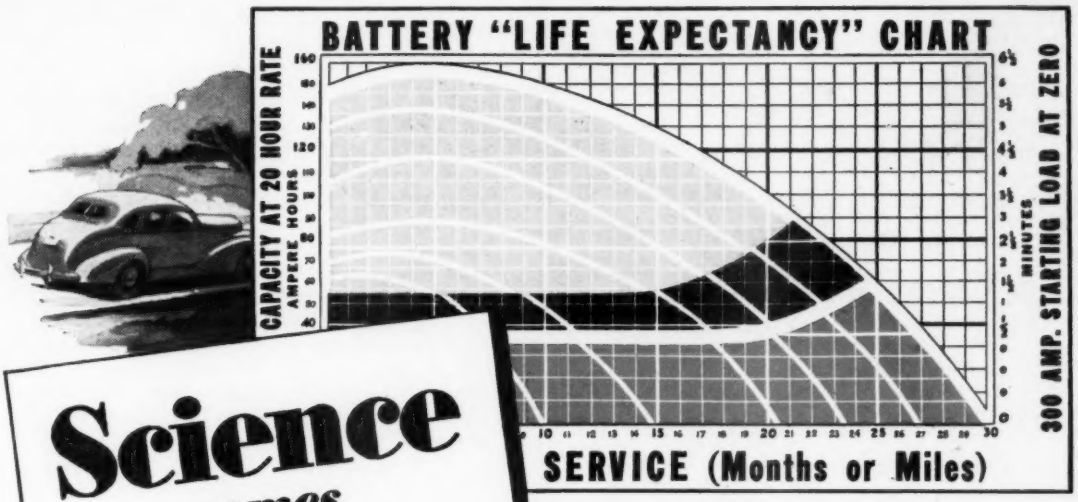
World's Fair Thrills

(Continued from page 78)

sters. A pathway makes the circuit of the "Venusian jungle," which sight-seers view through a "one-way" screen. This ingenious device preserves the illusion of reality by making spectators on the far side of the path invisible. At one point in the circuit, the rocket-ship visitors come to a "Martian headquarters." Here weirdly costumed Martians and mechanically animated models of giant beasts enact episodes from the adventures of Flash Gordon, interplanetary traveler of fiction.

But if the fair-goer prefers to "see the earth first," as travel agencies some day may urge us, another exhibit depicts one of the greatest of terrestrial wonders. Taking the visitor to Southern Rhodesia in Africa, a true-to-scale model reproduces in every detail the awe-inspiring Victoria Falls, more than twice as high and nearly twice as wide as Niagara. Enough water to float the *Queen Mary,* especially aërated to simulate the natural appearance of foam, drops two stories from the 180-foot-long brink of the miniature cataract. A spectator must shout at his nearest neighbor to make himself heard above the torrent's thunderous roar. Beautiful lighting effects vary the illumination to simulate an African dawn, midday, and sunset within a cycle of a few minutes' time. Projectors throw clouds upon a painted sky, and even the natural rainbow of the Victoria Falls will be duplicated. Spectators walk through tropical jungle growth, surrounded by the steamy air of the equator and by birds, animals, trees, and flowering plants imported from Africa, to approach the model. To give the final touch of realism, the trees decrease in size from the observer to the falls, so that the miniature cascade, with its illusion of perspective, looks like the real thing viewed from a great distance.

And these are just a few high lights of a medley of attractions designed to suit every taste in entertainment. If fairy-book romance appeals to you, you can stroll through an "enchanted forest," where the trees whisper to you as you pass. In case sheer speed is what gives you a kick, you can spin so fast around the rim of a bowl in an electric-powered train that your weight is tripled, your arms feel like lead if you try to raise them, and your feet seem glued to the floor! All the favorite thrillers of amusement parks, plus new ones like these, have been combined at the World's Fair to make up one of the greatest collections of fun makers and spectacles that have ever been assembled in a single spot.



Science comes to the rescue

Now You Don't Have to *Guess* When Your Automobile Battery Is Likely to Give Out—You Can *Know* Beforehand When to Replace

When to replace a battery? This has always been a major problem for car owners. Naturally, every driver hates to risk the inconvenience and annoyance of having a battery go dead, particularly since this seems to happen when time is short or help is hard to get. On the other hand, nobody wants to turn in a battery that still has plenty of life in it.

Now science provides the answer! Delco-Remy—manufacturer of Delco Batteries—conducted an intensive research program. Complete information was collected on the service given by thousands of batteries. This data was classified and grouped to establish the original Ampere Hour Capacity of each battery and to show the Units of service which each had given (in passenger car service a Unit equals one month, or 1000 miles).

These figures were then tabulated and plotted into curves, to form the Battery "Life Expectancy" Chart.

To determine the probable life of any battery, measured in terms of its ability to crank an engine at 0° F., all that is necessary is to know the original Ampere Hour Capacity of the battery. Find the curve of the particular battery on the chart and follow it until it is intersected by the line indicating the Units of service which the battery has given. That point shows the probable amount of life left in the battery, and when it should be replaced.

Stop in at your Delco Battery dealer's and let him demonstrate how the "Life Expectancy" Chart works. He will also supply you with a smaller copy of this chart if you are interested—just ask him for it.

Delco Batteries are known the world over for long, dependable, efficient service. That is why they are standard equipment on all General Motors cars and trucks. Make your next battery a Delco.

Delco-Remy

ANDERSON, INDIANA

Delco Battery sales and service requirements are available at United Motors Service Stations and dealers everywhere.

UNITED for SERVICE MOTORS

World's Largest Manufacturer of Automotive Electrical Equipment

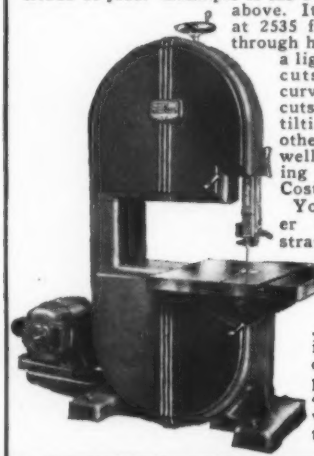
That's Gold —in my cellar-shop!

Hundreds of Driver-equipped home shops return a nice profit as well as a lot of fun!

It's a cinch to make money on your investment in Driver Power Tools. All around you are folks who want things made . . . who'll be glad to pay for the furniture, knickknacks, etc. you enjoy making. Try it! The new 1939 Driver Tools will prepare you for BUSINESS . . . enable you to turn out "professional" work that SELLS. Enable you to do it so easily that your "Business" will remain FUN for you.

YOU'LL WANT THIS NEW 14" BAND SAW

It's as slick in operation as it is in looks. Does a multitude of jobs. Example is the corner cupboard shown above. Its keen blade, travels at 2535 feet per minute; zips through heavy oak as easily as a light panel. Rips, crosscuts, makes accurate curved, angle and mitre cuts. Has a big 16"x16" tilting table and many other features. Built so well that big wood-working plants are using it. Costs little to own.



Your local Walker-Turner dealer will demonstrate this tool, also the new Driver 10" Geared Power Tilting Arbor Saw . . . the new 6" Jointer . . . new Metal-working Band Saw and others. Use the coupon to get the NEW 48-PAGE CATALOG which gives the details you want.

DRIVER Engineered POWER TOOLS

Walker-Turner Co., Inc.
239 South Ave., Plainfield, N. J.

I want your new 1939 Catalog of Driver Tools, accessories and motors.

Name.....

Address.....

.....

Raising Milk Goats

(Continued from page 107)

or Abyssinia; they are sometimes crossed with English goats to make them hardier. Alpines are sturdy, varicolored goats of ancient origin that come from the French Alps.

Goat ranches range all the way from the back-yard farm of the suburban cottager, who keeps several does for the family milk supply, to elaborate dairies, maintaining up to several hundred animals. In the latter, goats are raised under scrupulously hygienic conditions. Barns are immaculate, animals are regularly given blood tests for disease, workers are given thorough medical examinations weekly. All utensils that may touch the milk are sterilized, and each goat's udder is washed with a germicide before every milking. Milk is constantly checked by a medical examiner for sediment and bacteria.

One of the most scientific of the goat farms is the Three Winds Dairy, at Westbury, Long Island, N.Y., run by Juan M. Ceballos, Wall Street broker. Here seventy-five Saanens and Toggenburgs caper four hours a day in a grassy pasture, and lounge the rest of the time in a scientifically built barn. Ceballos is now experimenting to try to produce an odorless buck, by removing the musk glands.

Although there is little danger of goats competing to any great extent with cows, in the United States, the U.S. Department of Agriculture is actively experimenting with goat breeding in the hope that it may stimulate goat raising as an important animal industry. At its Animal Husbandry Experiment Station at Beltsville, Md., Government scientists are attempting to develop good but less expensive milk producers, by crossing pure Swiss breeds with American goats. If their efforts are successful they will add new impetus to this fast-growing hobby.

POPULAR SCIENCE Question Bee

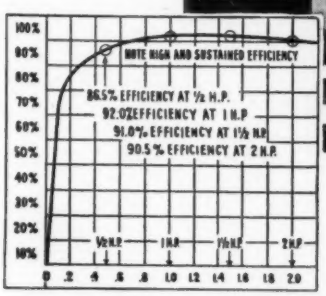
How did you fare in the Question Bee on page 152? In the list below, letters indicate the correct answers. Check your own list against it, and give yourself five points for every one that you got right. A total score of 75 to 85 points is good; 90 or better is excellent.

1. a	5. a	9. b	13. b	17. b
2. c	6. c	10. c	14. c	18. b
3. c	7. b	11. c	15. a	19. c
4. d	8. c	12. a	16. b	20. b

New Tilting Arbor Saw

Turns in Remarkable Performance

● Everywhere, men who use it, say this new Delta tool is the finest Tilting Arbor Saw on the market. Perfected after seven years of patient testing and experimenting—the new Delta Tilting Arbor Saw is the ideal circular saw for small shops, home workshops, schools, contractors, shipping and maintenance departments, woodworking plants—in fact wherever a compact low-price, *efficient* circular saw is needed. Some of its outstanding points are: Powerful fully enclosed motor; highly efficient "Tex-Rope" drive; perfected raising, lowering and tilting mechanism; new scientifically designed rigid housing; patented double-face, double-lock rip gauge; exclusive precision auto-set miter gauge; patented ripping extensions; sealed-for-life ball bearings; forged alloy-steel arbor; extra large table; "Point-of-use" controls and numerous other features. The full story of this new Delta tool and the complete 1939 line of Delta tools is found in the latest Delta Catalog. Send coupon for your FREE copy today.



Our tests showed that the "Tex-Rope" drive—while more expensive than a gear drive—was by far the most satisfactory and trouble-free drive that could be adopted. Tests made by an independent agency show that the efficiency of the drive is not only very high, but that it is sustained at a very high peak.

Delta Manufacturing Co.
600-634 E. Vienna Avenue, Milwaukee, Wisconsin

DELTA MFG. COMPANY, Dept. B339
600-634 E. Vienna Ave., Milwaukee, Wis.
Gentlemen: Please send me 1939 Delta Catalog and full details on the New Delta Tilting Arbor Saw.
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Address.....
City.....*State*.....
☐ Check here if you are a Delta user now.

VIKING - TWIN Garden Tractor
2 Cylinders - 5 H. P.
It Plows Harrows, Seeds, Cultivates, Mows, Does Belt Work Pulls Loads, etc.
1 Cylinder, 3½ H.P. Models
Write for Complete Catalog
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FREE "BETTER RESULTS WITH GLUE"

Send post card for booklet, "Better Results with Glue," containing many useful hints about mending, model making and home workshop jobs. Address: McCormick Sales Co., 404 Light St., Baltimore, Md.

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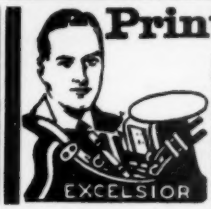
ATKINS *Silver Steel* **SAWS**
See your hardware dealer. Send for FREE Work-At-Home Book.
E. C. ATKINS AND COMPANY, 428 S. Illinois St., Indianapolis, Ind.

Print Your Own



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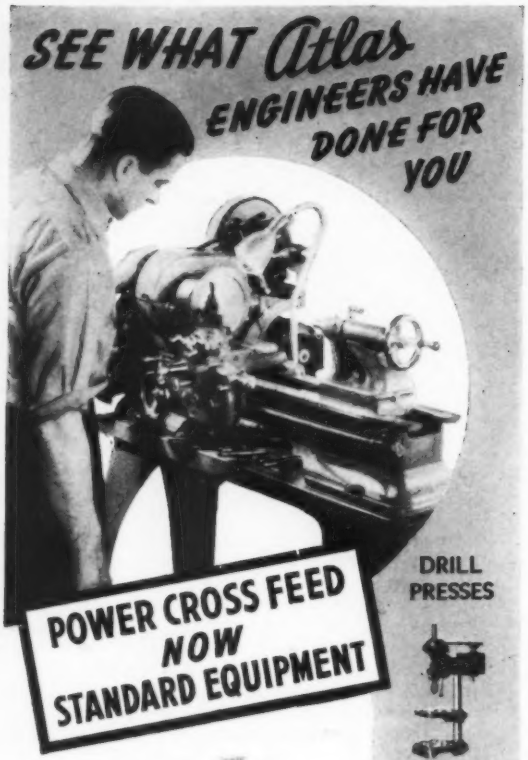

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It's the sweetest running lathe you've ever seen—complete V-belt drive, quick-change countershafts, compact controls, precision-ground bed ways, custom-built spindle bearings, back-geared power, and many other modern features. Prices, complete less motor, are $104.75 for horizontal countershaft, $99.75 for vertical countershaft. Ask your dealer to show it to you and explain the low monthly terms.

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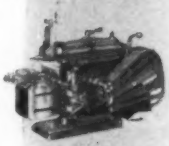

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1939 CATALOG

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ATLAS PRESS CO., 355 N. Pitcher St., Kalamazoo, Mich.

Send me your 1939 Catalog describing ☐ New 10" Metal Lathes ☐ New 6" Metal Lathe ☐ New 7" Shaper ☐ Drill Presses ☐ Arbor Presses ☐ Wood Lathes

Name.....
(Please print plainly)

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Ace Wildlife Photographer Brings 'Em Back on Film

(Continued from page 129)

after night for the wary animals to come within camera range. In the darkness, each night, he could hear the scurrying sound of a host of woodland jumping mice frolicking among the fallen leaves. Finally, on the eleventh night, he heard another sound, the stamping of a doe, floundering about in the mud at the edge of the lick. Cleaves switched on the lights and set his movie camera whirring. At the first sound, the deer bounded away in alarm. With a single leap, it cleared a four-foot embankment and ripped into the undergrowth. That jump took hardly half a second; it occupied only seven frames on the movie film running through the camera at sixteen frames a second!

Another long vigil, in a wild clearing in Cattaraugus County, in western New York, brought better results. During the daytime, for more than a week, Cleaves laid trails of bacon rinds, ham bones, and honey, seeking to attract black bears of the region to the clearing. During the night, he crouched within an empty steel barrel, his camera focused on a tree smeared with honey, his finger on the trigger of his flash gun. Eventually, he heard a bear sniffing about the clearing. When it began to lick off the honey, the great brute was so close that Cleaves could hear its tongue rasp on the bark. He set off his flash gun and a stab of brilliant light illuminated the wild scene. Then the woods went black again. But in that instant, his film had caught a magnificent bear picture, the 400-pound animal facing the camera, head lowered, eyes gleaming, tongue stopped in the midst of licking its lips over the tasty meal the photographer had provided.

Twenty-six years ago, Cleaves made his first wilderness movies through the help of Thomas A. Edison. In 1912, Cleaves, then in his early twenties, picked up a newspaper and read that Edison was planning a series of educational movies. He sat down and wrote the inventor a letter, explaining how he had been taking still pictures of birds and beasts in their natural surroundings and asking for a chance to make movies with one of Edison's cameras. In reply, he was told to bring some of his pictures, in the form of lantern slides, to Edison's Orange, N. J., laboratory. When Cleaves finished showing them, the famous inventor stalked out of the room with only three

(Continued on page 248)

SpeedWay

Real Quality Tools

Designed, manufactured and guaranteed by SpeedWay, for 30 years leading manufacturers of industrial drills, these are really fine tools, correctly designed, correct speeds, genuine high torque drill motors. Small, handy, powerful; 1000 RPM—drill handles to 1/4" in steel. Die cast handle and gear housing, $7.95. Grinder operates at 20,000 RPM (high speed is essential for good grinding) with collets for 1/8" and 3/32" arbors, $5.95. No. 250 KIT, both drill and grinder with 5 accessories in steel carrying case $14.96. Complete line of accessories and drill press stand. Write for Circular. **Dealers Write.**

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FARM MODEL $49.00

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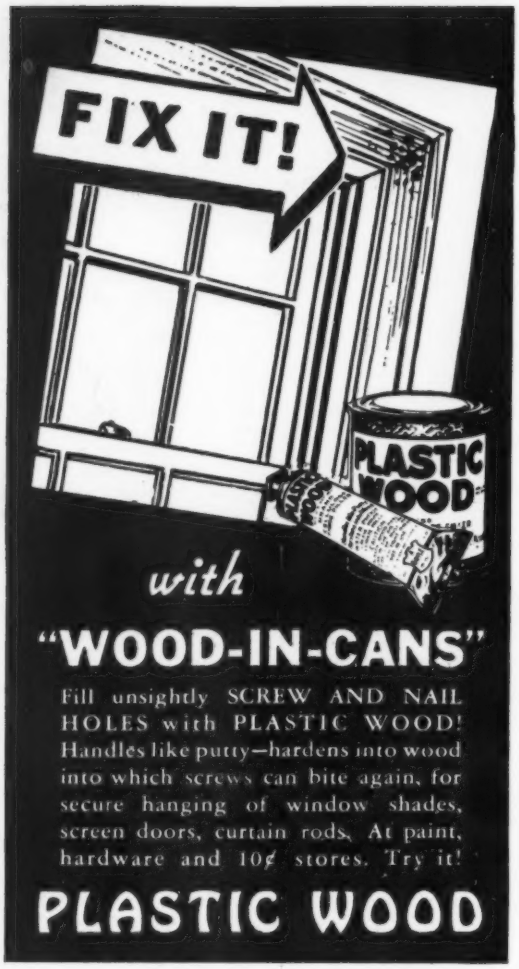

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FOR INTRODUCING. Here's a splendid opportunity for unusual sales and profits. Every car, truck, tractor owner a prospect. Send name and address now for big money making offer and how you can get yours Free.

The Vacu-matic Co., 7617-418 W. State Street, Wauwatosa, Wis.

Ace Wildlife Photographer Brings 'Em Back on Film

(Continued from page 246)

words. Addressing an assistant, he said: "Fix him up!"

So, in time, Cleaves was "fixed up" with a ponderous moving-picture camera and turned loose with $500 to bring back films showing the bird life of the South Carolina swamps. At Charleston, he rented a motor boat, hired an assistant, and set out for the depths of the swamplands. The first time he tried to film a colony of nesting herons, the clatter of the camera—resembling the noise of a moving machine—scared the birds away. Provisioning had been left to his Southern helper. Consequently, Cleaves lived for nearly three weeks on a diet of hominy grits. In the end, however, he returned north with several thousand feet of exposed film. After being edited, it was released both here and abroad as "Birds of the Southern Seacoast."

Not long afterwards, Edison closed up the producing end of his motion-picture business and it was years later before Cleaves could obtain a light thirty-five-millimeter camera suitable for filming action in the wilds. Some seasons, his wilderness trips net him only a thousand feet of film in addition to his stills. The greatest number of pictures he ever took in one year were snapped in 1928 when he accompanied the South Seas expedition organized by the former governor of Pennsylvania, Gifford Pinchot. During that seven-month voyage, Cleaves took 1,400 still pictures and 35,000 feet—approximately seven miles—of movie film.

Today, when he heads off on a photographic expedition to the wilderness, his mechanical equipment and his camping outfit ride in a specially designed trailer. Built like a cabinet on wheels, 't is seven feet long and four feet square. Within, compartments and shelves hold as much as 1,000 pounds of equipment. These accessories include such varied items as sleeping bags and frying pans, carpenter tools and flash guns, photoflood bulbs and electrical supplies. The sides of this curious vehicle are decorated with pictures of animals, birds, and insects. Made of plywood, the novel trailer weighs only 650 pounds when it is not loaded.

The completeness of his mechanical aids and the care Cleaves takes in preparation, play an important part in his remarkable success in catching fleeting moments of wilderness drama on film.

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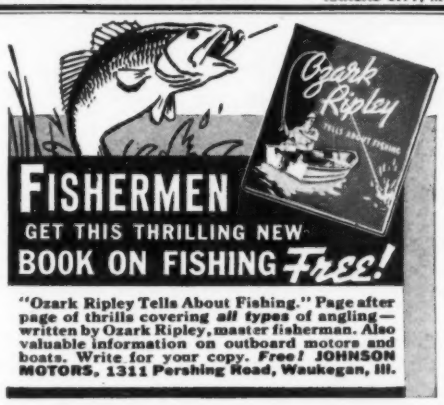

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have very important special features not possessed by others. For instance—the new ready-carved Leading Edge used on the PIPER CUB shown here—the latest Megow gas-powered model—a new, light weight size that avoids crackups. Wingspan 52¾". $3.95. By mail, 20c extra.

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EVINRUDE

9 GREAT EVINRUDES TO CHOOSE FROM

Low Bridge!

(Continued from page 121)

but the clearance expert is prepared for this. When a tall shipment leaves a main terminal, he sends copies of its time schedule to all power directors along the route. As the shipment approaches an underpass, the director in charge shuts off the current along that section of the line. The train coasts past the danger point, and the power is turned on once more.

Boats give the clearance expert some nice headaches, especially in getting them through tunnels. During the flood emergencies of recent years, the U.S. Coast Guard repeatedly have shipped huge boats overland to the stricken areas. Ordinarily this would have been an all-but-impossible job, but by lifting the boats over bridges with derricks when necessary, and by suspending regular traffic for hours at a time, the railroads did the job. Every single vessel got through.

There is one clearance problem that the railroads hope will never arise—the military one. In a war fought on American soil, the rapid movement of giant artillery might easily play a decisive role. Army engineers, aware of the potential hazard of low clearances, have made a special study of the problem as applied to transportation of military equipment. The results of that survey are confidential, but the layman wonders what would happen if an irresistible force in the shape of a huge cannon should meet an immovable object in the form of a low bridge.

King of Drugs

(Continued from page 66)

and skin rash, they explained, these minor complications disappear quickly when the drug is administered, as it always should be, under the direction of a doctor. One authority stated that there had been only ten deaths in 4,000 cases where sulfanilamide had been properly used, with no positive indication that the drug itself had caused any of them.

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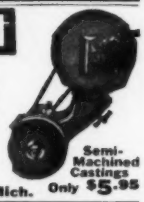

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BUILD Boucher MODELS
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3-IN-ONE OIL

Try Your Hand at Organic Chemistry

(Continued from page 209)

others, like aspirin, as medicinal preparations.

You can test the purity of organic chemical compounds by determining their melting points. To do this, heat a length of glass tubing red-hot in the Bunsen flame, and pull it out into a thread. Take an inch-and-a-half piece of the filament that has an internal diameter of about a fiftieth of an inch, and seal one end by holding it in a flame. Put the chemical to be tested—say, your homemade acetamide—in this tiny test tube by inverting the tube, and tapping the open end lightly upon a small heap of the compound. Then attach the tube to a thermometer, right side up, with a rubber band. Insert the thermometer bulb and the filled portion of the tube in water, and heat the water. The crystals of acetamide will melt, becoming clear and transparent. Read the temperature when this happens. The acetamide should melt at about eighty-two degrees centigrade (180 degrees Fahrenheit). If the observed melting point differs from this by more than three degrees centigrade, or five degrees Fahrenheit, it is impure. You can perform similar tests upon substances that melt above the boiling point of water, by using strong phosphoric acid instead of water for the heating bath.

Suppose you have two white powders, and want to find out whether they are the same organic chemical. One way to do it would be to determine their melting points, as just described. Here is a simpler idea, with which no thermometer is required. Make tiny piles of each of the powders, about the size of grains of rice, half an inch apart on an inch-wide strip of copper. Between them, pile an equal quantity of a finely pulverized mixture of the two powders. Finally, place another small heap of either one of the two powders in front of these three piles. Heat the extreme end of the copper strip, which should be several inches long. When the nearest or "sentry" pile begins to melt, watch the other three piles closely. If the chemicals in them are alike, they will melt at the same time. When the chemicals are different, the center pile of mixed powders will melt first. The chemical with the lower melting point will melt next, and the chemical with the higher melting point last.

With this method, even two substances like aspirin and phenacetin, which melt at 132 and 134 degrees centigrade (270 and 273 degrees Fahrenheit) respectively, can be distinguished from each other.

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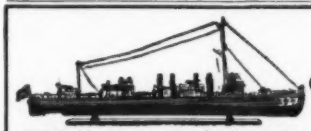

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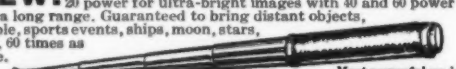

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What Kind of Wood Is It?

(Continued from page 215)

uncover the structure for microscopic study. One is directly across the grain, as you already have done. A second is radially, along a plane extending from the center of the trunk outward, and parallel with the grain. A third way is to make a tangential cut, which is on a plane perpendicular to the radial cut and parallel to the grain. Sometimes a fourth section, diagonally across the trunk, will reveal interesting details.

The tangential section will show the sides of many of the cells. Study the cell walls closely. You will observe some of the tracheid cells tapering to a blunt point. You can see in a specimen of white pine that the tracheids are equipped with series of doughnutlike markings. These are called bordered pits, and really are valves through which the sap passes from cell to cell. Also in the tangential section, you will see groups of cells in cross section making a pattern somewhat like a diamond that tapers gradually at both ends. These are the medullary rays seen in cross section.

Medullary rays are groups of cells running radially through the wood. That is, the cells are in lines extending from the center of the trunk outward, although they do not necessarily run all the way. Their purpose is to furnish channels for the cross flow of fluid circulating through the tree.

For further facts about the structure of wood and stems, you can consult any good botany textbook.

Although sections of wood, cut with a knife, razor, or even a sharp carpenter's plane, can be examined immediately without further preparation, you will find it interesting to try various stunts to modify the appearance. For instance, a cross section of white pine, which by ordinary illumination appears dark against a light field, will seem more beautiful and more natural by dark-field illumination produced by using a substage condenser and masking off the central portion with a disk of opaque material. Since cellulose rotates the plane of polarization, wood sections can be examined by polarized light (P. S. M., Dec. '36, p. 52, and Oct. '38, p. 200), showing details not otherwise visible.

And, of course, you can employ various stains to modify the appearance of wood structure. Safranine, used usually as a saturated or half-saturated solution in water, is a common stain for such purpose. If the wood is naturally dark, like walnut, you can bleach it with chlorine laundry bleach (sodium hypochlorite) before staining.